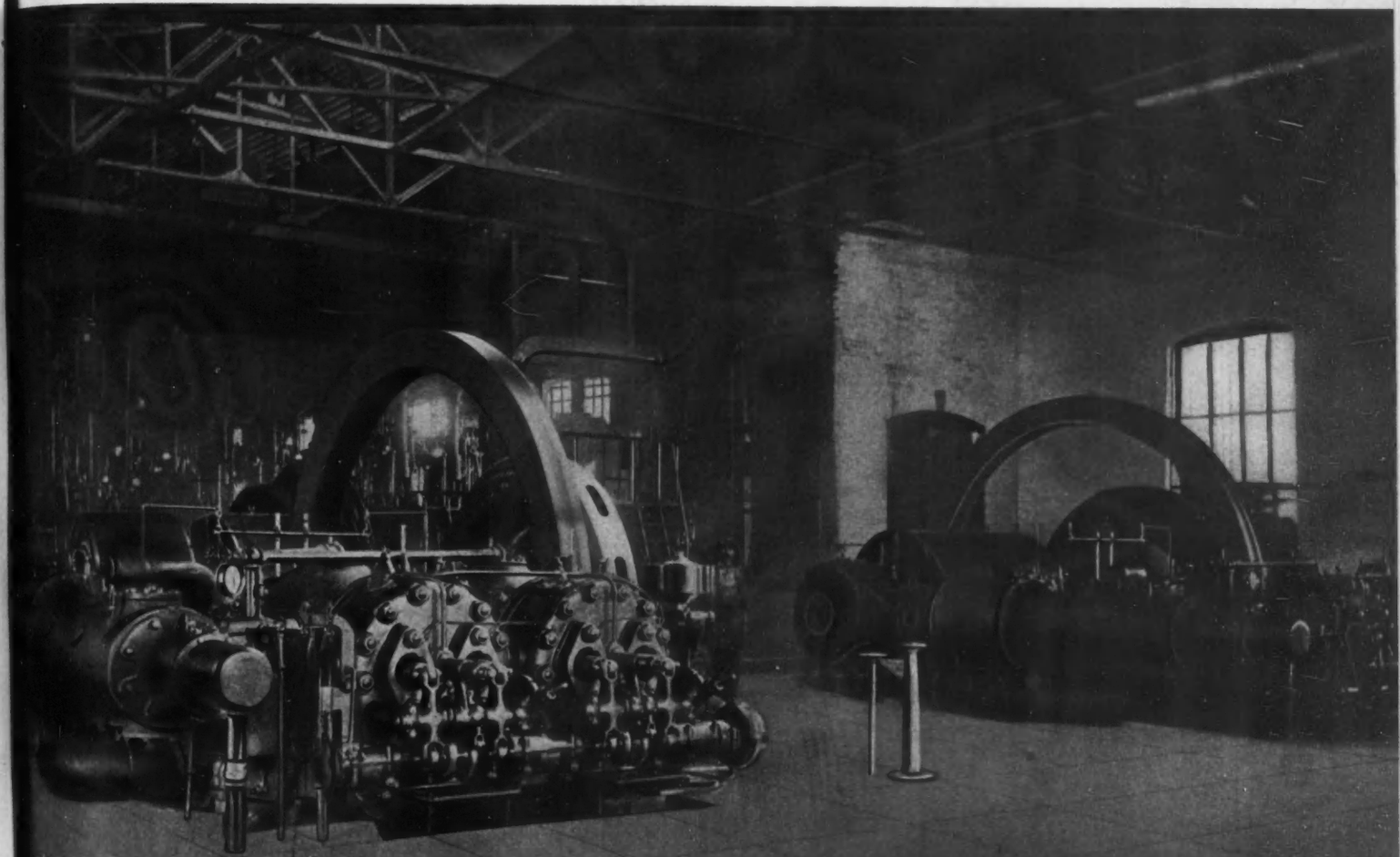
Installation of Power Station Lighting Units—Electrical Precipitation of Smoke and Fumes—System of Numbering Customers' Meters and Other Articles on Operating Practice.

PERIODICAL RECEIVED MAY 17 1916

Electrical World

Volume 67 Number 20 McGraw Publishing Co., Inc. New York, May 13, 1916



SNOW

Oil Engine Reliability

2000 H.P. in this plant—24 hours a day—six days a week, for over two years.

This photo shows two of four 500 H.P. twin cylinder Snow Oil Engines driving 60-cycle a.c. generators in parallel in the plant of the Prairie Pebble Phosphate Company.

The fact that these Snow Oil Engines are operating **successfully** on **heavy asphaltum base Mexican crude oil** is significant to those who desire **economical** prime movers.

OPERATING CHARACTERISTICS OF THE SNOW ENGINE

Runs without vibration. **No ignition apparatus necessary.**
No explosion shocks. **High Compression type.**
Complete combustion.

IMPORTANT ANNOUNCEMENT ON PAGE 15

Write us for Catalog S-130-38.

WORTHINGTON PUMP AND MACHINERY CORPORATION

Successor to International Steam Pump Co., 115 BROADWAY, NEW YORK

Snow Steam Pump Plant, Buffalo, N. Y.

Branch Offices in all Principal Cities.

Atlanta Boston Buffalo Chicago Cincinnati Cleveland Denver Detroit El Paso Houston Kansas City
Los Angeles New Orleans Philadelphia Pittsburgh St. Paul St. Louis Salt Lake City San Francisco Seattle

Weston

Specialization—
What It Accomplishes and What It Means

There is a revelation in store for the Engineer who for the first time examines the *interior* of any Weston A. C. Switchboard Instrument.

And the more familiar he may be with the design and workmanship in other makes of A. C. Instruments, the more startling that revelation will be.

"An exquisite piece of engineering design and construction"—this will be the first impression imparted by this inside inspection of the Weston Instrument.

Then, attention will naturally travel to the excellent workmanship of the various parts, and to the grace and strength of the various members that comprise the movable elements.

A little further examination will reveal an almost unbelievable number of instances of perfection of detail, evidencing beyond any doubt that no matter how minute or for what purpose intended no single feature of the Instrument has escaped the closest study.

The design and construction of a thoroughly accurate and serviceable A. C. Measuring Instrument presents problems as intricate and requires workmanship as skillful as any mechanical, electrical or electromechanical contrivance known.

Everybody knows that since the Weston D. C. Instruments were first made they have stood pre-eminent throughout the world in quality and workmanship. It is an absolute fact that the difference between Weston *A. C.* Instruments and those of any other make is even more marked.

Any Engineer who is open to conviction will instantly recognize that these Weston Instruments are masterpieces of the instrument maker's art.

Any Engineer will immediately understand that Specialization—incessant concentration—could alone have produced so remarkable a result.

Yet this attention to detail, this high grade of workmanship, is not wrought for visual effect nor as a mechanical feat. On the contrary, it is a result of one sole guiding motive, namely: that of rendering service. Every refinement or perfection of detail bears directly upon this one final aim and object of these magnificent Instruments.

The Engineer who selects and uses Weston A. C. Switchboard Instruments may rest assured that should trouble ever occur in his plant it will be found elsewhere than in his Instrument equipment. This feeling of confidence goes with the Instruments.

In the interest of the greatest economy and efficiency of your plant, investigate these matters before deciding upon your Electrical Measuring Instruments.

Home Office and Factory
Waverly Park, Newark, N. J.

New York	Boston	Chicago	St. Louis	Detroit	Toronto	London
Philadelphia	Cincinnati	Cleveland	Denver	Montreal	Vancouver	Florence
Buffalo	Richmond	Pittsburgh	San Francisco	Winnipeg	Paris	Petrograd

Berlin, Johannesburg, South Africa

Weston Electrical Instrument Co.

Electrical World

The consolidation of ELECTRICAL WORLD AND ENGINEER and AMERICAN ELECTRICIAN.
Published by McGraw Publishing Company, Inc.

Vol. 67 NEW YORK, SATURDAY, MAY 13, 1916 No. 20

Record Performance of Steam Turbine

IT is pleasant to note that on the first authoritative and published tests of a 30,000-kw. cross-compound steam turbine hangs a tale as important to the managers of public utilities as are the results to the engineering profession. In this particular case, the substitution of a steam turbine for an engine has affected the fixed charges enormously. Not only does it enable the capacity of the station to be increased six times without further expenditure for buildings or boilers, but it displaces a unit costing $40 a kilowatt by a necessarily more efficient machine costing only $9 a kilowatt. The change also means that 40 per cent less coal is required per kilowatt-hour than formerly.

The performance of the unit, as given elsewhere in this issue, amply establishes the enviable position of the steam turbine as a prime mover, and the machine itself is a monument to machine design. Engines, which at the time of their installation represented the acme of perfection as prime movers, have been outclassed by it in operating efficiency, cost, space requirements and ability to handle swinging loads. And, though this were not enough, the engines found no buyers but the junk dealer. It is also interesting to note that although it was decided two years ago to use this new type of turbine, changes in the art of design and operation in the interim have been such that the same company will now install a 70,000-kw. cross-compound unit with three generators, any one of which may be operated independently if desired. Thus the art of generating electricity in steam-turbine driven stations has advanced to a point where up to load factors of approximately 60 per cent, a kilowatt-hour of electrical energy can be manufactured more cheaply by this means than by water power.

How Electric Drives Reduce Costs

MOTOR drives lend themselves so admirably to the machine processes in factories, that their consideration by the manufacturer who has studied the problems of increasing the output in his factory may almost be taken for granted. But the electrical engineer has a peculiar opportunity to extend the use of motor drives by explaining to those factory managers who are not so familiar with modern methods just how he may reduce his costs by better factory layouts, more direct methods of routing work, and so on. A woodworking plant, let us say, has a band re-saw that is not in continuous operation. Perhaps during two days a week that particular machine is busy getting out stock. The remainder of the week it stands idle. This machine, because it is used on part-time work, is often located out of the line of the regular machinery, in a corner or in a separate room. To drive this tool in a belt-driven factory the manufacturer has to run a line of shafting and pulleys idly a great part of the week. Obviously, here is a plain case for eliminating a friction loss by driving that machine with an individual electric motor. Interest the manufacturer in this obvious case and he can see all the more clearly the advantages of motor drives throughout his plant.

Similar instances can be found in nearly every line of industry. Take the question of routing material in a department. Industrial engineers recognize that if material in process of manufacture can be routed in one direction without retracing its course through a factory or department, the cost of doing the work will be greatly reduced. But to get this "straight line production" it is necessary, let us say, to place two machines at right angles and drive them both from the same line shaft. An interesting mechanical problem presents itself if belt drive is the only solution. Quarter-turn belts waste power. More than that, they wear out and need constant attention. But an electric motor can be installed with the machine in any position, and the best arrangement for improving production can be determined without mechanical difficulties. All of which emphasizes the main fact that the electrical engineer to-day must sometimes be an industrial engineer, and the more he knows about the manufacturer's problems of output and cost the wider can he extend the use of electricity in the factory.

Better Lighting for Power Houses

SOLUTIONS of power-house lighting, as dealt with elsewhere in this issue, present practical suggestions to the constructor. It is a fact that lighting in a power house is usually an afterthought, whereas it is of much importance in the practical handling of the plant and deserves skillful attention. The main difficulties ordinarily encountered in working out the illumination problem are the height of the building and the awkward necessity of locating lamps where the usual traveling crane will not foul them. In a fairly open station, not too lofty, lamps with suitable reflectors above them can be swung conveniently from the roof girders just well clear of the crane. This position greatly facilitates care of the lamps and fixtures and gives well distributed illumination. Failing in this, perhaps the most convenient place is that illustrated in the article, where the lamps are carried in brackets swung from the main pillars which support the roof truss, well below the level of the crane. This method of arranging the lamps re-

sults in well-distributed general illumination. The N. E. L. A. recommendation of 2½ ft. candles on the working plane is followed in determining the amount of general illumination. Following out the practice which is suitable in the lighting of large spaces generally, the lamps should be of rather high power and provided with individual switches. In a majority of cases, gas-filled lamps are the most suitable for general illumination, although for special uses, as around the switchboard, small lamps are useful. Nowhere is more light wasted than in the buildings housing the electric light industry, chiefly because it is nobody's special business to look after the economical use of light and it is quite dropped out of sight.

In the installation of a lighting system for a power house there are several rather special requirements. First, the switchboard must be provided throughout with lamps which will make every instrument readable and every switch instantly accessible. Individual lighting or the illumination of small groups of instruments is, for several reasons, desirable for giving the best light on the pointers without glare in the eyes of the operator, and with the minimum expenditure of energy. Economy in energy at this point is desirable for a secondary reason as well as on general principles. Under no circumstances should it be possible for the station, with its great equipment of running machinery, to be left in darkness in case of accident. This is a fundamental consideration. The time when an accident happens is the very moment when good illumination is most necessary. To this end it is very common to provide a double-throw switch enabling the station lighting to be put either on one of the regular circuits or upon the exciter bus, so that in case of trouble the lighting circuits can be operated from this auxiliary service. The switchboard lamps, however, are likely to fail with the rest, and hence it is rather good practice to run these, at least in part, from the storage battery used for switching service and the like, so that if the circuits go off the operator can at least have enough light to see the switches and transfer the lighting to the exciter bus.

Electricity for Bakeries

LOCAL bakeries, like laundries, offer opportunities for the sale of electric current supplied from the central station. Energy for the electric bakery is called for at midnight when the average load curve has its lowest valley. Experience on the Western Coast indicates also that the initial cost of the electric equipment is lower than that of brick ovens now usually applied, and it is claimed that the cost for current is not prohibitive. Operating costs depend, as is often the case, on the intelligent use of the electric oven by the operator. One bake oven installed at Portland made the first baking with a consumption of 48 kw.-hr. This was disappointingly high. On the second day the baker regulated the heat more carefully and the baking was equally well done with a consumption of 35 kw.-hr. Oven heats on the third day were regulated according to the more intimate knowledge of the manufacturers' representative who was present. The consumption for the same baking on the third day was 24 kw.-hr. If the consumption had been 3 kw.-hr. lower than this minimum the current cost would have just equalled the cost of the wood formerly used in the same shop. In point of revenue the bake oven is one of the most, if not the most, desirable kind of load that has yet appeared in the Western field. One bake oven installed on the Pacific Coast increased the power company's current income in the ratio of $3,000 per year. Not the least important factor in the development of this business, aside from the engineering and cost questions involved, is the advertising value to the baker of electricity for baking and other purposes. Cleanliness and certainty of temperature control are factors which can be suitably advertised to the public. With electrically-driven mixing machinery and electric delivery wagons the baker has a basis for a striking advertising campaign of his own.

Costs of Public Illumination

IT is a most unusual occurrence to find complete and thorough records of the operating expenses in plants of moderate size. The reports from two Kansas plants given in the current issue are, therefore, especially interesting, the more so since they are municipal plants, from which accurate records are relatively scarce. The two cities concerned are Topeka and McPherson, Kan. The former has nearly 50,000 inhabitants, the latter about 3500. Both cities have the advantage of comparatively cheap coal. In Topeka the plant furnishes power only for street, ornamental and sign lighting, so that its performance is not altogether comparable with that of an ordinary commercial generating station. The plant in the smaller city does general service. Both are rather underloaded, which does not make for economical operation. The Topeka plant shows a consumption of about 6 lb. of coal per kilowatt-hour, while the McPherson plant consumes nearly 9 lb. However, due to cheap coal, both give fairly low operating charges for plants of this size—between 1.6 cents and 1.7 cents per kilowatt hour. In each case the cost of fuel is slightly more than half the total operating expense. An analysis of the exact figures, as shown in the tables of the reports, will prove valuable to the station operator. For Topeka the figures showing interest, depreciation and the loss of taxes to be charged against the municipal operation are included in the data given, and amount approximately to one-third of the total cost of plant working, including administration.

For the McPherson plant these items are not included. In other respects the data are exceptionally complete. It is hard to overestimate the importance of really knowing the actual cost of operating a plant. A good deal is known about generating expenses, but it is altogether rare to find anything like a complete record of the distribution of expenses for the complete operation, particularly for systems of moderate size. The relative investment in various parts of the system are

especially instructive. In the case of Topeka the generating plant equipment is less than a third of the whole capital invested, and the largest item is the "white way" system to which the city has treated itself—nearly 38 per cent of the total investment. The large expense of the arc-lamp outfit, too, is noticeable, this being nearly 30 per cent of the total for the outside equipment, with about 11½ per cent more added for the rectifiers in the station which serves the arc circuits. Details like these throw considerable light on some of the necessary costs involved in public illumination.

Obviating Smoke, Dust and Fumes

ELECTRICAL precipitation is applicable to two different fields, namely, in the clarification of air by the removal of suspended particles of dust or smoke; and, in the condensation of vapors containing suspended particles of previously atomized material. It is well known that electrified particles, suspended in air or other gas, move rapidly toward oppositely electrified plates, walls or barriers. In discharging against these plates, the particles ordinarily adhere to them and disappear from the air. Consequently, if the particles of smoke or dust, suspended in the air, can be electrified and provided with suitable discharging surfaces, clarification of the air can be effected. A practical difficulty in the way of removing fog and dust from the air of cities lies in the enormous scale on which the electrification must be carried out, in order to be effective, and the great consequent expense of the installation and operation. When, however, finely divided material is atomized and released into the air of a room, the suspended particles tend slowly to settle under gravitational force but a very appreciable quantity tends also to be blown away by gusts through any open vent before settling can occur. In such a case electrical precipitation offers a propitious opportunity for economical employment, the expense of the electrification being, perhaps, much less than the expense of the waste material carried away by the air.

The article by Halbert P. Hill, on page 1097, describes various practical precipitators. The method in each case consists in electrifying positively a rod, or prime conductor, insulatedly supported in the path of the escaping vapors, the surrounding metallic walls carrying a negative opposing charge. The charge on the prime conductor is rapidly imparted to the suspended particles, to say nothing of accidental leakage; so that a substantially steady direct current has to be supplied to the conductor at a relatively high pressure, representing a certain average quantity of electrical energy per cubic meter of treated air. In order to supply this direct-current power, a high-tension alternating current is rectified by a revolving commutator. This rectifier has to be carefully designed and operated in order to obtain the most satisfactory result. A considerable portion of the article, therefore, is devoted to its description. It seems likely that an ideal arrangement would employ a perfectly uniform direct-current voltage. In practice, of course, any such rectification system must produce fluctuations in the delivered direct-current voltage and charge. These fluctuations react prejudicially on the generating transformer, to say nothing of their action on the precipitator itself. It is to be hoped that precipitators such as described may be so far developed and simplified as to be capable of being applied to smoke chambers, chimneys, and other objectionable cloud producers in our cities.

Keeping Meter Records

KEEPING meter records has sorely tried central station meter departments which have had to wrestle with the problem of keeping a clean account of meters of manifold variety. If meter manufacturers would go to the trouble of providing easily-legible nameplates there would be small need for special systems of classification, but as a matter of fact the ordinary meter nameplate is small, neat and illegible, so that the meter men are often hard put to it to get at an inaccessible instrument in order to read its number. Incidentally, considerable improvement can be made in the form of the numbers used on nameplates and instrument scales. A. P. Trotter, the veteran English engineer, has recently suggested typical forms of numbers which can be easily read, even when somewhat imperfect, and which ought to be extensively used for this reason.

The plan adopted by the Potomac Electric Company, explained in this issue, while it appears complicated is in reality rather practical. It consists in stamping all the meters in use clearly, in conspicuous numbers on the dials, with key letters and numbers which indicate at once to the meter department the type, rating, connection and serial number in the company's service. The record consists of a key number to show the meter rating; a key letter or letters to designate the type and make; another key number to indicate the character of the meter connection and the voltage, and finally the specific number of the meter itself. The completed symbol looks like a football signal set up in type, but it tells the whole story and is found in practice greatly to facilitate the keeping of the necessary records, both in the meter department and in the consumer's ledger.

The Coming Issues

Next week, under date of May 20, the ELECTRICAL WORLD will issue its annual pre-convention number preceding the thirty-ninth annual convention of the National Electric Light Association to be held at Chicago on May 22 to 26. In the following issue, dated May 27, a complete report of the convention will appear, recounting the news features of the meetings and presenting abstracts of the papers and discussions at the general, commercial, electric-vehicle, transmission and accounting sessions. Both issues summarize conditions of interest to all readers.

Chronicle of Events of the Industry and of Important Movements in the Field

NEWS OF THE WEEK

Reports of Conventions and Meetings of Electrical Associations and Societies

Iowa Utilities Discuss Profit-Sharing Franchise

Joint Convention of Electric, Gas and Railway Associations at Dubuque Takes Up Questions of Public Policy

Assembled in Dubuque, Iowa, on May 10 in the first session of the first joint convention of the Iowa section of the National Electric Light Association, the Iowa District Gas Association and the Iowa Street and Interurban Railway Association, the joint body was addressed by George McLean, president Key City Gas Company of Dubuque, on the subject of the theory of public utility franchises. He summed up his theory in the word mutuality, and offered a plan of profit-sharing franchise as a guarantee of this mutuality.

The plan contemplates a standard rate and standard dividend, which dividend is not to be guaranteed by the city but is to be retained by the company if it succeeds in earning it. The dividend should be cumulative, should correspond to the rates the banks of the community charge on loans carrying hazards equal to those borne by the Public Service Company, and should be based on the value of the property devoted by the company to the public service. Further net earnings, if any, should go to a reserve fund until the latter reach a certain proportion of the capitalization, based on the inventory value of the company's property. The reserve should be used when necessary to maintain the property or meet a deficit in the standard dividend, and should be available for no other purpose. Any surplus which might accumulate after meeting the requirements of the reserve or emergency fund should be divided between the company and its patrons on a sliding scale. Any dividend above the standard allowed the company out of this surplus should be apportioned to and be dependent upon its rebates to consumers.

Thus, a particular concession in the rate should give the right to a particular increase in the dividend, and a further concession in the rate should authorize a further increase in the dividend. Under this plan the rate would be automatically adjusted to the worth of the service to the consumer. His rebate or dividend would rise or fall with the prosperity of the company, and the company's right of participation in the earnings above the standard dividend would be its sufficient motive for endeavoring to operate the property with the utmost economy and to increase the profitable business from year to year. Its success in these particulars would measure not only the consumer's return but its own.

The meeting was presided over by E. M. Walker, president of the Electrical Association and general manager of the Union Electric Company of Dubuque, and a welcome to the city was extended by Mayor James Saul. H. C. Blackwell, vice-president of the Peoples Light Company of Davenport, responded to the Mayor's welcome. At the Wednesday afternoon separate session of the Electrical Association President Walker recommended in his address the establishment of a permanent office for the association at Des Moines in order to care properly for the increased amount of work the various committees are doing. He called attention to the importance of the hearings before the board of railroad commissioners of Iowa on telephone interference, and said that the matter of having the engineering department of the University of Iowa conduct special tests was under consideration. He also stated that a joint legislative committee of the three associations then convening should be appointed as the most economical and efficient manner of observing legislation in which public-service companies are interested.

J. M. Deabelle, electrical engineer of the Iowa Railway & Light Company of Cedar Rapids, presented a most complete and valuable report of the telephone interference committee, which is intended as a textbook for member companies. The reports of the public relations committee and the special accounting committee were presented by the respective chairmen, H. C. Blackwell of Davenport and C. E. Fahrney of Ottumwa.

City Rejects Los Angeles Lighting Companies' Offer

Proposal to Turn Over Properties to City in Five Years at Valuation Fixed by Commission Voted Down and Two-Year Counter Proposition Made

The Los Angeles City Council on May 3 rejected the proposal that the city sell aqueduct power wholesale to the private lighting companies, and at the end of a five or ten-year period purchase the distributing systems of the companies at a price to be determined by the Railroad Commission.

As a counter proposition to the one refused, the Council decided to offer to purchase the municipal distributing systems from any or all of the three private companies at a price to be arrived at, by appraisers selected by both parties, on the basis that no allowance would be made for severance damage; this purchase to be consummated at the end of a two-year period, during the first year of which the city would pay as rental 7 per cent of the appraised value, which would be reduced to 6 per cent during the second year. This proposal is to be made through the board of public service commissioners, the recommendation being that a time limit of sixty days should be placed upon the acceptance or rejection by the private companies.

On April 22, through the president and secretary of the Chamber of Commerce, a proposal, now rejected, was made to the City Council by the Southern California Edison Company and the Pacific Light & Power Corporation to turn over their plants to the city at the end of either five or ten years. This offer was made with the idea of preventing wasteful duplication of distributing systems within the city limits. The proposal contained six provisions, summarized as follows:

1. To sell the distributing systems with business attached within the city of Los Angeles, excepting service to street railways and such parts of the distributing systems as are necessary to furnish such service, on Jan. 1, 1922, or Jan. 1, 1927, at the option of the city. Provision was made for the determination of just compensation for the properties, the companies agreeing to accept as final and conclusive the findings of the Railroad Commission, provided the city of Los Angeles would

agree to do likewise. Actual costs of additions to the properties from Jan. 1, 1917, to be added to the price fixed by the California Railroad Commission.

2. The city of Los Angeles to agree to sell to the two companies for the period covered by the option all of the hydroelectric power generated at the city's aqueduct plants on the Owens River.

3. The price to be paid by the companies to the city of Los Angeles to be $20 per peak-horsepower per annum, or such price as may be determined by the Railroad Commission.

4. The city to proceed with the immediate development of its first power installation, and complete its second power installation within three years.

5. The maximum rate for electricity to be 5 cents per kilowatt-hour from Jan. 1, 1917, with a corresponding reduction in rates other than maximum.

6. The lighting companies to maintain all lines in first-class condition and to continue the development of business as heretofore.

The offer of the power companies for the purchase of power it is estimated would mean an income of $1,200,000 per annum when the first two of the city's plants are in operation.

Referendum Petition Also Presented

A referendum petition signed by 11,000 citizens and taxpayers of Los Angeles, advocating the sale of municipal power to the power corporations and opposing the duplication by the city of the private power companies' distribution systems, was presented at a meeting of the City Council on April 14, and was referred to the public utility and public service committees. The delegation was headed by Col. W. H. Holabird and Robert A. Rowan, chairman and secretary respectively of the business men's committee. The text of the petition is as follows:

"The undersigned, taxpayers to the city of Los Angeles, urge upon the City Council, through the business men's committee, immediate action to stop all plans and all building of an electrical distribution system by the city, and recommends making some arrangement with the existing power and electrical companies for the distribution of all electricity to be generated by the city, either by selling the energy at wholesale to the companies who have invested millions of dollars in distributing systems, or by such other arrangement as may seem wise to your honorable body, with all the necessary safeguards as to prices of electricity for wholesale and retail."

Statement of City Engineer

Chief Electrical Engineer Scattergood of the city's power bureau, spoke before the Los Angeles City Club on April 15 in reply to the presentation of the petition. After giving a review of the financial status of the municipal hydroelectric system he pointed out that if a municipal electrical generating and distributing system is established, with 60 per cent of the business attached, the taxpayers will be wholly relieved from taxation for power bonds, the rates for street lighting will be materially reduced, with a resulting saving to the taxpayers, and the average rates for all classes of electrical service to the city and its inhabitants could be reduced on an average of 25 per cent, with much greater reduction in rates for industrial power for encouragement of industries, for the benefit of all. In other words, the net results of the establishment of a municipal system as described would be entire relief to taxpayers from taxation for power bonds and a saving of at least $1,000,000 annually to the electrical consumers in this city, who now pay more than $4,000,000 annually to the power companies for such service.

Changes in the N.E.L.A. Convention Program

But few changes have occurred up to date in the program of the thirty-ninth annual convention of the National Electric Light Association, to be held in Chicago, Ill., on May 22-29. In addition to those changes announced in the ELECTRICAL WORLD of last week the principal change occurs in the meetings of the electrical-vehicle section.

The program as first announced in the ELECTRICAL WORLD of April 22 showed that the meetings of this section would be held on Wednesday morning, Wednesday afternoon and Thursday morning. According to the latest arrangements, the first session will be held on Wednesday afternoon and the remaining two sessions on Thursday morning and afternoon respectively.

There are also a few other minor changes in the program, consisting principally of changes in the order of presentation of certain papers.

Water-Power Bills Temporarily Sidetracked

Water-power legislation is temporarily side-tracked in both branches of Congress, and no definite provision has yet been made for including these bills in the legislative program. The House has passed a bill providing for the development of water power on the public domain, but that bill is yet to pass the Senate. On the other hand, the Senate has passed a bill providing for power development on navigable streams, but this measure has never been called up in the House.

President Wilson, in conference with Senate and House leaders, has several times indicated a desire that Congress pass water-power bills without going into details as to the exact form of legislation which he himself desires. Secretary Lane also has expressed the hope that water-power legislation will not be allowed to go over to another session, and a similar sentiment was voiced by Secretary Garrison before he retired from the Cabinet.

The understanding between the administration and the leaders in Congress is that there will be water-power legislation before adjournment. But up to the present time, neither House of Congress has included the pending water-power bills in its program of legislation—that is to say, neither House has fixed a time when the bills now on the respective calendars shall be considered.

The Committee on Rules, which largely determines the order of business in the House of Representatives, has made no provision for taking up the Adamson bill, and has no immediate intention of giving that measure precedence over the shipping bill, appropriation bills, army and navy legislation, or conference reports. These measures of higher privilege will occupy the full time of the House for several weeks to come, but it is the hope and the expectation of Representative Adamson, in charge of the House substitute for the Shields bill, to get as much time as may be necessary for the water-power bill, just before or immediately after the national conventions in June.

If the Myers bill passes the Senate it will then be referred to a conference committee, in order that the differences between that measure and the Ferris bill, for which it was substituted, may be compromised. When the conference committee reaches an agreement, the conference report must be adopted by Senate and House before the bill can be submitted to the President for signature. And a conference will also be necessary on the Shields-Adamson bill, if the House passes the bill now on its calendar.

There is no prospect that either water-power bill will become a law in the immediate future. It will be late in July, or some time in August, before one or both of these measures can be sent to the White House for the President's approval.

Convention of Iowa Electrical Contractors

The sixth semi-annual convention of the Iowa Electrical Contractors' Associations was held in Dubuque on May 10 simultaneously with the joint session of the Iowa Gas, Street Railway and Electrical Associations, and its members were invited to attend the joint sessions of these associations. This courtesy was taken advantage of and the joint sessions made a part of the contractors' program.

Methods of meeting "curbstone" competition and costs of operating were discussed by the members. In his paper on the former, Lanis L. Corry of Davenport defined a "curbstoner" in the final analysis as any contractor who does not get legitimate profit, and gave as the reason for his existence, lack of knowledge of business and contracting principles. Mr. Corry analyzed several possible ways of meeting the "curbstoner," and concluded that the only way to eliminate him was by educating him in legitimate contracting methods. He suggested exchanging men with other contractors as a desirable means of keeping down the number of lost hours and, consequently, the overhead.

In a paper on cost of doing business, J. E. Sweeney of Waterloo emphasized the importance of maintaining salary and loss accounts if an exact knowledge of the business profit, overhead charges, etc., is to be had. The report of the national director of the association, George O. May, of Sioux City, was read by E. Kunkle of the Tri-City Electric Company of Davenport.

N.E.L.A. Power Sales and Industrial Heating Bureau to Consolidate

A meeting of the power sales bureau of the commercial section of the National Electric Light Association was held at the office of the association, New York City, on Tuesday last.

The principal question of discussion was the consolidation of the power sales bureau and the newly-formed industrial heating bureau. The industrial heating bureau has already discussed this question, and passed a motion that the two sections affiliate themselves under the name of the industrial sales bureau. The power sales bureau at its meeting unanimously passed this same motion, and a letter to the chairman of the commercial section was prepared and signed by the secretaries of the power sales bureau and the industrial heating bureau.

The general division of the work of the proposed industrial sales bureau is as follows: Electrochemical division, general power (including railway supply) division, electric heating division, isolated plant division.

A recommendation was made to the commercial section that the executive committee of the industrial sales bureau should consist of the chairman, vice-chairman and secretary, together with the officers of the four divisions mentioned, and members at large, not to exceed four, to be appointed by the chairman. The various committees reported that the papers for the coming convention were now finished and ready for distribution. The banquet committee reported that all arrangements had been made for the dinner to be held at the University Club of Chicago on Tuesday evening, May 23, and that a large attendance is expected.

Annual Meeting of Society for Electrical Development Adjourned

Lacking a quorum, the annual meeting of the Society for Electrical Development, which was scheduled for Tuesday, was adjourned subject to the call of the president. It is probable that the annual meeting will be held about the time of the annual convention of the National Electric Light Association, or shortly after. Meanwhile copies of the annual reports of the treasurer and of the general manager will be mailed to the members.

Discussion on Safety Code

Experience Brought Out at Meetings of Bureau of Standards Engineering Conference at Atlanta, Ga.

At the sessions of the Bureau of Standards engineering conference held at Atlanta, Ga., on May 2, 3 and 4, under the auspices of the affiliated technical societies of Atlanta, considerable experience in electrical work affected by rulings of the national electrical safety code were brought out. The order of business and an abstract of the important papers were presented in last week's issue of this paper.

Overhead Construction

In connection with the rules dealing with strength of overhead construction, P. A. Tillery of Raleigh, N. C., expressed some fear that the special crossing-pole requirements called for too great strength in the direction of the line. He referred to one crossing of a large number of heavy conductors in Raleigh where head guying to comply with the rules would require four 16,000-lb. guys. It was brought out, however, that even heavier guying would be necessary where so heavy a line is deflected at an angle, and that the hazard at a railroad crossing is reinforced by the importance of such a heavy line, making the installation of heavy guys a well warranted expense in such cases.

L. V. Sutton of Raleigh, N. C., and Mr. Cummins of Birmingham, Ala., commented on the rather large sags called for by the rules. In this connection, however, it was made clear that certain listed sags could be reduced to a point where under the maximum wind and ice loading of the district, the stress would not exceed one-half the breaking strength of the wire. It was also brought out that the sags given for longer spans and large conductors in the tables of the code are correct minimums for covered solid wire, and that additional tables are being prepared for the bare wires under these conditions. The rules are so worded as to permit some reduction of sag where warranted by lack of insulating covering and use of stranded conductors. Mr. Sutton suggested that the heavier conductors in the short city spans might reasonably be permitted to be made of soft copper even above 750 volts. The rules now permit soft copper only under that voltage. This matter was taken under consideration by the bureau engineers who suggested that the low yield point of soft copper requires so considerable a sag that its use for higher voltages would for safety need to be very carefully limited by the rules to very short spans and heavy wires.

The discussion on the rules on overhead construction developed the fact that, as stated by Mr. Tillery, probably 95 per cent of the code could be accepted, in the light of rather general experience, as reasonable and practicable. Only a few matters appeared to be still in serious question.

Electrolysis Mitigation

In regard to electrolysis and its mitigation, Elam Miller of the American Telephone & Telegraph Com-

pany stated that the Bell companies have relied on cable drainage for protection in the past. This is frequently the only relief measure adopted in certain cities. This method has not only proved less satisfactory as a protective measure, but has involved a larger total expenditure than rightly should be made by the owner of an endangered structure. Pipes, however, which are less continuous, and more intimately in contact with the earth, cannot be drained so effectively and attempts to employ the palliative used with some success by the cable owners usually prove ineffective or even disastrous through increase of joint electrolysis. Mr. Miller called attention to the practical absence of serious electrolytic damage in Europe, where the cable owners have had little or no call to apply drainage because of the general use of insulated negative feeders.

G. T. Yundt of the Southern Bell Telephone & Telegraph Company, placed the total investment in the Southern States in underground structures at about $100,000,000. He showed that even where the trouble is slow and comes to light only at intervals it may amount to $1,000,000 or more a year.

Prof. A. F. Ganz of Stevens Institute of Technology, Hoboken, N. J., described pipe coverings of compound poured into a surrounding box, which had in some cases of important pipe lines proved their worth as secondary means of protection, although ordinarily these covers were too expensive to be contemplated. The speaker placed little value on so-called electrolysis surveys which are made by engineers recommending pipe drainage in which voltage readings are taken between the rails and the piping in question, in order to plot maps showing respectively where pipes are positive to rails. Professor Ganz also showed lantern slides illustrating peculiar cases of electrolysis and a chart showing the relative amount of leakage current from the rails of a given trolley system, accordingly as the negative bus is grounded to an earth plate, connected direct to one end of the rail or connected through several insulated feeders to various taps in the rail, demonstrating that the total earth currents which must be reckoned with as causing electrolysis of buried structures are reducible to a very small percentage of those originally existing provided use is made of insulated feeders.

PROTECTIVE GROUNDING OF DISTRIBUTION CIRCUITS

In regard to protective grounding of distribution circuits, Mr. Sutton urged that where artificial grounds are used their number should be increased enough to bring the resistance very low. He referred to the value of brine and good surface contact in this connection. If artificial grounds are permitted to have as high a resistance as the rules allow, horses and even persons, under extreme circumstances, are endangered by the potentials liable to exist from the ground wires or pipes to the surrounding earth surface. Because of this danger he suggested that insulating guards be used generally for such ground connections, and that metal guards be used only with very low resistance connections, such as those to water pipes.

Mr. Tillery brought up the subject of ground connections to transformer cases on poles. This practice seems to have proved generally undesirable on wood poles. Professor Ganz emphasized the necessity, with extended common ground wire systems, of avoiding connections to different piping systems or both piping and track returns. He urged that water companies permit connections in accordance with the code rules, and stated that, in some cases coming under his notice, a water system management had opposed ground connections solely on the basis that the lighting company would, by such connections, avoid the necessity for installing extended buried returns for low resistance bond to earth.

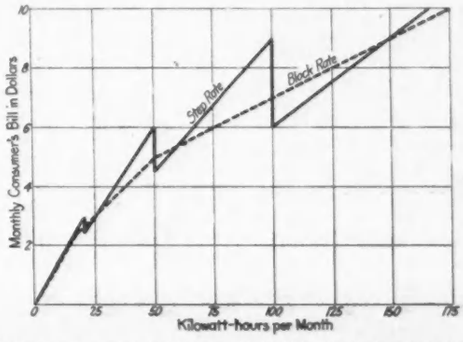
Mr. McDowell of Savannah, Ga., asked whether gas pipes should be strapped to water pipes and was informed that this appears undesirable and is prohibited by the rules. He referred to several cases of fatalities resulting from ungrounded equipment frames, especially of switch inclosures, and urged their grounding in conformity with the rules.

W. G. Claytor of Roanoke, Va., and others discussed the advantage of permitting as small as No. 10 wire for ground connections to circuits in multiple with an initial No. 6 wire connection.

The conference was concluded with a resolution introduced by Mr. Tillery, commending the bureau and its work in connection with the safety code, indorsing the code for introduction and tentative trial as amended and revised in the light of the suggestions offered at the Atlanta meeting and the further conferences before its publication. This resolution was passed.

Block Rate Superseding Step Rate

As fast as practicable, the Illinois Public Utilities Commission is endeavoring to rule the so-called "step" rate, which is inherently discriminatory in character, out of existence, and is substituting therefor an undis-



EQUIVALENT STEP AND BLOCK FORMS OF ELECTRIC RATES

criminatory block rate. A typical step rate would be as follows:

	Per Kilowatt-hour
1. For consumptions between 1 kw.-hr. and 20 kw.-hr. per month	15 cents
2. For consumptions between 20 kw.-hr. and 50 kw.-hr. per month	12 cents
3. For consumptions between 50 kw.-hr. and 100 kw.-hr. per month	9 cents
4. For consumptions over 100 kw.-hr. per month	8 cents

The unfair discrimination is apparent only by making computations of a couple of particular bills. Assuming that a consumer uses 19 kw.-hr. in a certain month, his bill amounts to $2.85. Should the consumer have used 21 kw.-hr., his bill for the month would have been $2.52. In other words, a consumption of 2 kw.-hr. more per month results in a bill which is 33 cents less. This unfair discrimination between consumers exists at every step in the rate schedule.

To eliminate the step feature, it has been necessary to establish an equivalent block rate of a form somewhat as follows:

	Per Kilowatt-hour
1. For the first 15 kw.-hr. used per month	15 cents
2. For the next 35 kw.-hr. used per month	10 cents
3. For all electricity used over 50 kw.-hr. per month	4 cents

These two rate schedules will produce approximately the same annual revenues to a utility. The manner in which step rate and the block rate affect the monthly bills is shown graphically in the accompanying illustration.

Performance of 30,000-Kw. Steam Turbo-Generators

Water Rate for Varying Loads, Thermal and Rankine Cycle Efficiencies and Summarized Results of Tests on Units in Seventy-Fourth Street Generating Station of the Interborough Rapid Transit Company, New York City

THE results of preliminary and acceptance tests showing a water rate of 11.3 to 11.4 lb. per kilowatt-hour for the 30,000-kw. cross-compound steam turbine units of the Interborough Rapid Transit Company of New York, when the machines were running under load conditions and carrying the maximum rated load were officially confirmed by the records of tests presented in a paper by H. G. Stott and W. S. Finley, Jr., at the May 8 meeting of the American Society of Mechanical Engineers. According to the summarization of test data on this installation shown in Fig. 3 and Table I, the water rate at the most efficient load, namely 26,740 kw., is given as 11.25 lb. per kilowatt-hour with a thermal efficiency for the unit of 24.81 per cent. This remarkable performance record is ample proof of the high place which the steam turbine now holds as a prime mover of large rating operated under rather wide ranges of load, varying between 30 per cent and 60 per cent of the average.

The three 30,000-kw. units now operated at the Seventy-second Street station of the Interborough Rapid Transit Company were ordered in 1913. The first unit was started on Dec. 29, 1914, the second on Feb. 24, 1915, and the third on July 30, 1915. The engineering details in connection with the remodeling of the Seventy-fourth Street Station and the installation of these machines were fully outlined in the April 17, 1915, issue of the ELECTRICAL WORLD. In brief, each unit consists of two elements, a high-pressure and a low-pressure. The former is practically a typical single cylinder reaction turbine containing thirty-eight rows of blades, and the low-pressure element is of the double-flow type. The accompanying illustrations of Fig. 2 show the construction of rotors and casings. The high-pressure rotor is of relatively small diameter and operates at the maximum speed possible for 25-cycle service, namely, 1500 r.p.m. The low-pressure rotor was designed for the next lower synchronous speed of 750 r.p.m., utilizing a four-pole generator.

The surface condensers installed consist of two shells containing 25,000 sq. ft. of condensing surface each. These shells are connected directly to the turbine outlets without an intermediate expansion joint. Duplicate turbine-driven tri-rotor circulating pumps rated at 37,500 gal. per minute are used. The hot-well pumps are installed in duplicate, and a single rotary dry vacuum pump is provided for each unit sufficiently large to handle the dry air from two units being cross-connected for the purpose.

RESULTS OF TESTS

The results of twenty-five tests are tabulated in Table I and shown by the curves of Fig. 3. In conducting these tests certain standard conditions under which guarantees had been made were maintained. The data as given have been corrected to such standards which the authors of the paper state represent average of operating pratice. Attention is called to the following particular features of the curves and data:

1. With due allowance for scale of ordinates the performance curves may be considered unusually flat, naturally conducive to high plant efficiency.

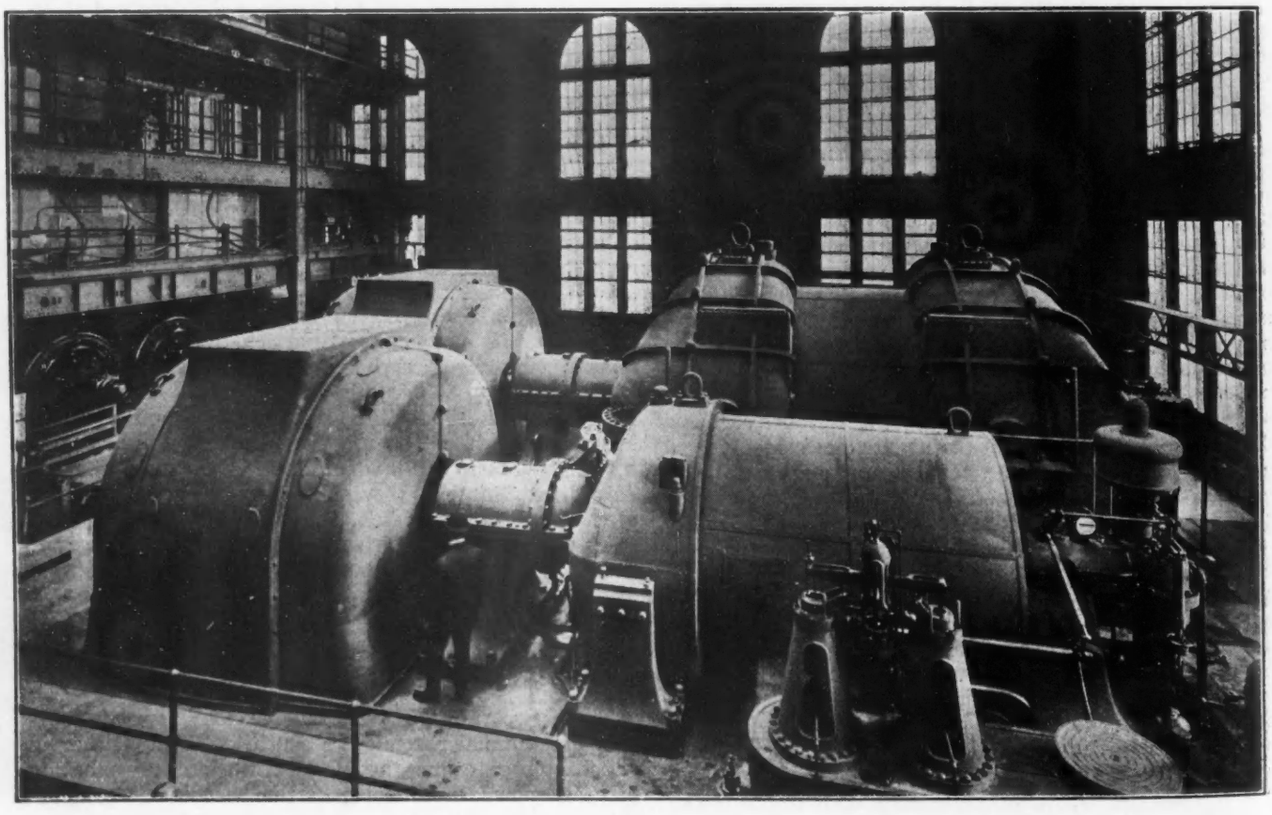


FIG. 1—ONE OF THREE 30,000-KW. CROSS-COMPOUND STEAM TURBINES IN INTERBOROUGH STATION

2. The dip in the curve between 22,000 kw. and 26,000 kw. is a peculiarity which was received at first skeptically, but which was later remarkably checked by repetition of tests throughout the range, including a special series under steady load made three months subsequent to the original series and given herein as Nos. 22-26 in the tables showing test summaries. Various theories have been advanced in connection with this dip and a series of special tests was made to investigate the relative action of the receiver between the two cylinders as a separator, and the velocities of the steam passing through it, with the idea that this might have some direct bearing upon this dip. Unfortunately, winter load demands terminated further research work in this direction without any definite results having been obtained.

3. The turning up of the efficiency curve between 30,000 and 32,000 kw. is another peculiarity, accounted for by the turbine designer as follows:

"Concerning the supposed inconsistency in these tests, that is, the turning up of the efficiency curve between 30,000 and 32,000 kw., consideration and figuring indicate that this is actually not an inconsistency, but a new experience. This turbine was designed for higher hydraulic efficiency than probably any machine heretofore built, thus approaching the crest of the efficiency curve. The overload capacity of the machine is small, or in other words, the amount the turbine is by-passed when the secondary valve opens is small, and the velocity ratio, therefore, is very little lower when full steam pressure is applied to the secondary inlet than when such pressure is applied to the primary inlet. Further, the hydraulic efficiency is nearly the same, so that the Rankine cycle at 32,000 kw. should not be more than 1 per cent lower than at the point of best efficiency, namely, 26,000 kw. The efficiency at the intermediate overload, say, 30,000 kw., is somewhat worse than this, for while the blading and hydraulic efficiencies remain as high there is a loss due to a certain portion of the steam expanding through the secondary valve to a lower pressure without doing work."

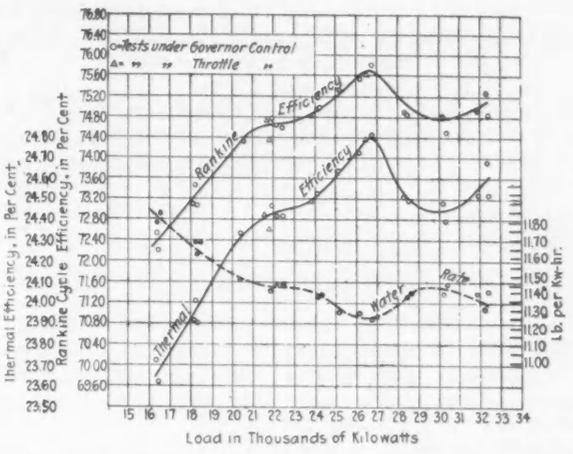


FIG. 3—WATER RATE AND EFFICIENCY CURVES FOR ONE 30,000-KW. UNIT

A number of tests were made upon the condensers, auxiliaries, separate and individual, guarantees having been made upon the condenser proper, circulating pumps, dry vacuum pumps and hot-well pumps. The results of the tests upon the condenser are given in Table II. The guarantees were based upon operation under maximum load, namely, about 32,000 kw., and the test was made with the turbine carrying as near that load as was possible. The duration of this test was three hours, and the preliminary operation under test conditions was half an hour. No corrections were made in this test, as operating conditions approximated the guaranteed conditions very closely with the exception that air leakage was high. The tests were made very shortly after the installation of the machine and little opportunity had been given under operating require-

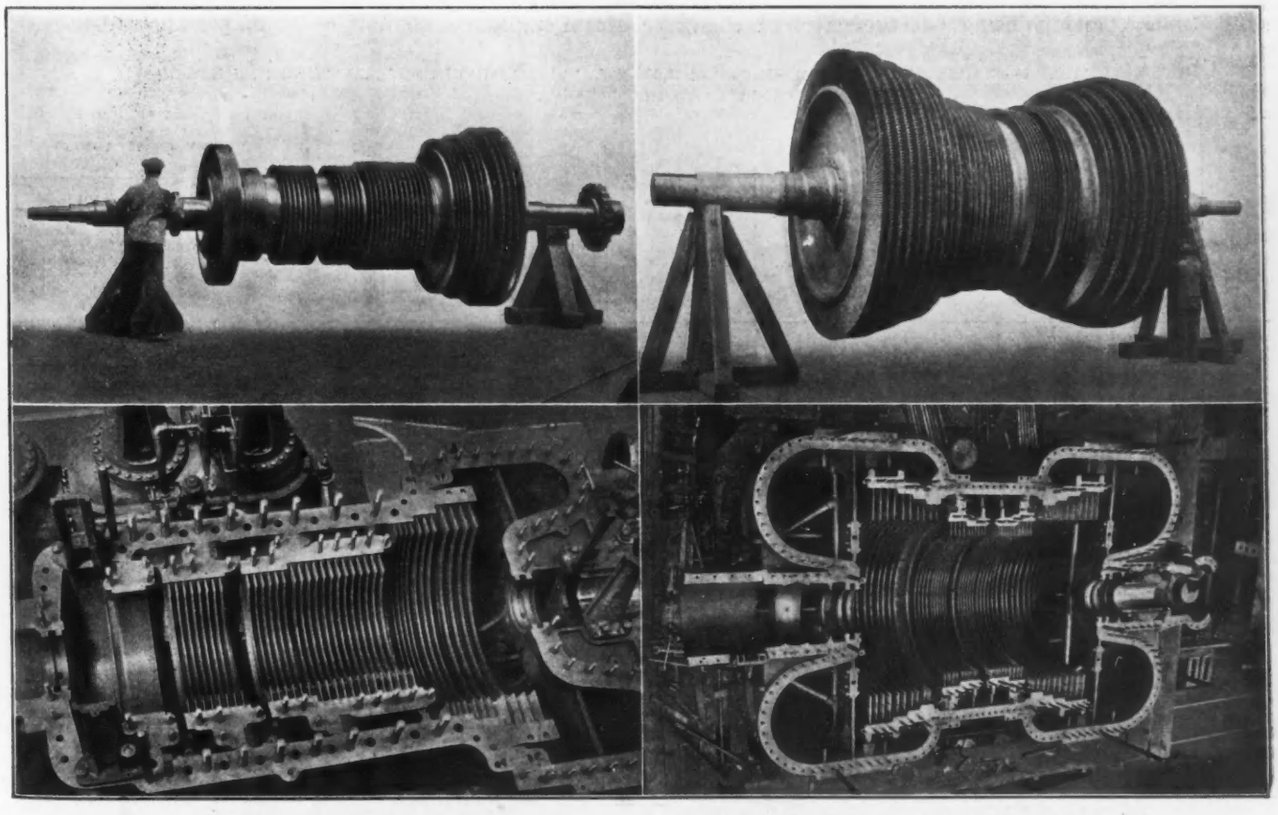


FIG. 2—HIGH AND LOW PRESSURE ROTORS AND CASINGS FOR 30,000-KW. INTERBOROUGH TURBINES

ments properly to eliminate this leakage, which has since been done. A permanent gasometer has recently been installed in connection with each unit, in order to observe air leakage at regular intervals.

In summarizing the results of these tests, the authors stated that the performance in the case of both turbine and condenser showed higher efficiencies than was guaranteed under contract, and the installation has proved to be thoroughly satisfactory in every particular, having fully realized considerations governing the selection.

Discussion on Turbine and Plant Operation

Before the reading of the paper, which is briefly abstracted in what is presented here, H. G. Stott, superintendent of motive power of the Interborough Rapid Transit Company, reviewed the evolution of steam station design since the construction of the Seventy-fourth Street station in 1900. The station then housed eight Reynolds Allis-Chalmers steam engines of a double combination horizontal-vertical cross-compound design. Each unit was rated at 5000 kw., with a maximum rating of 7500 kw. In a space no greater than taken by one of these units a 30,000 turbine unit now stands, operated from the same boilers now equipped with underfeed stokers, and superheaters to give 200 deg. of superheat when the boilers are delivering three times their rated output. The boiler pressure is 205 lb. per square inch gage. The steam engines operated originally on 175 lb. gage and no superheat. Mr. Stott called attention to the comparison in investments represented by the two types of installations, the cost of engines, generators and condensers being $40 per kilowatt, while the cost of the new turbines and condensers is $9 per kilowatt. The steam engine water rate was 17 lb. per kilowatt-hour as compared with about 11.4 for the turbines operating under similar load conditions.

Francis Hodgkinson, the designer of the Interborough turbines, discussed the features of the water rate curve, showing by means of lantern slides, construction features of the separator between the high and low-pressure elements and pointing out the effect of changes in separator elements on the pressure drop and quality of steam. Better results with rippled baffles were secured at low rates of steam flow and worse at higher rates. He explained further the effect of the secondary valve action shown by the dip and rise of the water rate curve between 26,000 and 30,000 kw., also mentioned under heading No. 3 of results of the tests.

J. P. Sparrow, chief engineer of the New York Edison Company, referred to the increase in boiler ratings at the waterside stations in New York City, pointing out that in the "old buckwheat coal days" the fuel consumption was about 3.5 lb. per kilowatt-hour, while at the present time with remodeled boilers installations and operation using soft coal 1.8 lb. per kilowatt-hour is the average figure.

R. J. S. Pigott, who was associated with Mr. Stott in the operation and reconstruction of the Seventy-fourth Street station, referred to the operation of separators with and without baffles in the Fifty-ninth Street station. He also mentioned the substitution of rubber instead of metal joints to overcome expansion difficulties.

In closing the discussion Mr. Stott stated in answer to questions that the average thermal efficiency of the Seventy-fourth Street equipment is 17 per cent and that the coal consumption is 1.5 per kilowatt-hour as against a monthly average, including auxiliaries for the steam engine installation, of 2.5 lb. per kilowatt-hour.

Table 2—Condenser Test, Summary of Results

Pressure at throttle (pounds per square inch)	220
Temperature at throttle (degrees Fahrenheit)	487
Superheat (degrees Fahrenheit)	97
Load (average kilowatts)	31,233
Exhaust vacuum (inch mercury)	28.61
Exhaust pressure (inches mercury absolute)	1.39
Corresponding temperature (degrees Fahrenheit)	89.4
Mean temperature difference (degrees Fahrenheit)	12.9
Heat transferred per hour (B.t.u.)	316,000,000
Heat transferred per unit surface per hour (B.t.u. per square foot)	6,330
Heat transferred per unit surface per hour per degree mean temperature difference (B.t.u. per square foot)	490
Air leakage (cubic foot per minute)	16.88
Condensate (pound per hour)	357,060
Temperature of hot well water (degrees Fahrenheit)	86
Temperature of intake water (degrees Fahrenheit)	70.8
Temperature of discharge water (degrees Fahrenheit)	80.9
Rise (degrees Fahrenheit)	10.1
Circulating water (gallons per minute)	64,700

TABLE I—SUMMARY OF TEST[2] RESULTS FOR 30,000 KW. CROSS COMPOUND STEAM TURBINE UNITS OF INTERBOROUGH RAPID TRANSIT COMPANY, NEW YORK CITY

Test No.	Abs. Steam Pressure at Throttle, Lb. per Sq. In.	Steam Temperature at Throttle, Deg. Fahr.	Superheat, Deg. Fahr.	Abs. Steam Pressure Primary Inlet, Lb. per Sq. In.	Abs. Steam Pressure Exhaust H.P., Lb. per Sq. In.	Abs. Steam Pressure Inlet L.P., Lb. per Sq. In.	Exhaust Vacuum, In. Hg.	Exh. Pres. Referred to 30-in. Bar, 58.1 Deg. Fahr., In. Hg.	Load Average, Kw.	Water per Hour, Lb.	Water* Rate, Lb. per Kw.-Hr.	Rankine* Cycle Efficiency, per Cent	Thermal* Efficiency, per Cent	FROM GRAPHIC LOAD CHART: Ratio of Maximum Load Range to Average Load	FROM GRAPHIC LOAD CHART: Ratio of Average Load Range for 2.5-Min. Periods to Average Load
1	224.3	493.2	101.6	148	10.6	10.2	28.411	1.589	16,342	192,350	11.770	72.540	23.72	65.5	37.2
2	223.3	486.8	95.8	144	11.8	10.0	28.52	1.48	16,447	194,431	11.822	72.222	23.62	63.8	37.7
3	224.1	485.7	94.2	166	....	11.0	28.539	1.461	18,158	212,029	11.677	73.118	23.91	56.2	31.3
4	223.3	489.6	98.4	159	11.8	11.5	28.471	1.529	18,273	212,330	11.620	73.476	24.02	69.5	58.6
5	222.6	496.5	105.7	163	11.8	10.8	28.588	1.412	18,317	213,976	11.682	73.086	23.90	56.8	34.7
6	220.4	510.9	121.0	175	12.7	12.0	28.586	1.414	20,472	234,930	11.476	74.400	24.33	34.2	18.6
7	219.8	519.3	129.5	182	12.8	12.5	28.683	1.317	21,925	250,407	11.421	74.757	24.46	51.1	17.1
8	221.8	518.8	128.0	185	13.5	12.8	28.791	1.209	22,150	253,388	11.439	74.630	24.41	49.2	19.0
9	221.1	501.5	111.2	187	....	13.0	28.744	1.256	22,432	256,716	11.444	74.606	24.41	37.9	20.4
10	221.3	513.9	123.5	194	14.2	14.1	28.902	1.098	24,137	274,971	11.392	74.947	24.52	37.7	15.3
11	220.3	512.9	123.0	196	13.7	13.6	28.882	1.118	24,200	275,593	11.388	74.973	24.52	29.3	13.1
12	220.3	496.8	106.8	197	14.6	14.1	28.896	1.104	25,170	285,184	11.330	75.357	24.63	30.6	13.0
13	217.9	524.3	135.2	211	14.5	14.7	28.761	1.239	26,153	295,373	11.294	75.597	24.72	33.3	11.8
14	224.0	500.0	108.5	215	....	15.0	28.862	1.138	26,740	301,035	11.258	75.840	24.81	....	....
15	221.6	510.0	119.5	210	16.5	15.9	28.862	1.138	28,378	323,353	11.395	74.928	24.51	41.2	13.0
16	220.0	155.5	125.6	211	16.6	16.2	28.812	1.188	28,517	325,072	11.399	74.901	24.49	22.8	7.7
17	220.3	513.0	123.0	210	16.5	16.8	28.78	1.22	30,232	344,787	11.405	74.862	24.48	25.1	10.1
18	217.2	518.0	129.1	206	17.3	17.2	28.801	1.199	30,397	348,018	11.449	74.574	24.39	27.0	9.1
19	217.1	515.4	126.6	212	18.5	18.5	28.623	1.377	31,986	364,280	11.389	74.968	24.52	18.1	7.7
20	218.2	519.5	130.4	209	17.6	18.2	28.75	1.25	32,348	366,572	11.332	75.343	24.64	14.2	7.7
21	216.3	513.3	124.9	209	18.1	18.9	28.765	1.235	32,490	370,335	11.398	74.908	24.52	....	....
22	222.8	518.0	127.0	182	13.9	13.0	28.55	1.45	21,610	246,661	11.414	74.733	24.42	....	....
23	224.0	508.0	116.5	186	14.2	13.3	28.53	1.47	21,800	250,134	11.474	74.412	24.35	....	....
24	222.9	512.0	121.0	194	14.8	13.9	28.92	1.08	23,890	272,335	11.400	74.824	24.48	....	....
25	223.1	515.4	124.3	213	16.2	15.1	28.85	1.15	26,505	298,810	11.274	75.660	24.79	....	....

*As corrected to 215 lb. per sq. in. or 15.1 Kg. per sq. cm. Abs. Press.; 120 Deg. Fahr. (66.6 Deg. Cent.), super heat; 29 in. Hg. (736.6 mm.)

[2]Duration of each test was three hours.

Installation of Lighting Units in Power Stations

Selection and Mounting of Lighting Fixtures and Arrangements to Provide Satisfactory Illumination for Machine Floors, Switchboards, High Tension, Storage Battery and Boiler Rooms

BY M. M. SAMUELS

IN the Dec. 18 issue of the ELECTRICAL WORLD an editorial comment appeared under the heading "The Cobbler's Barefoot Children," in which some deficiencies in power-station lighting and the injudicious placing of units were pointed out and attention called to faults in the lighting of some of our very best power plants. While it must be admitted that the lighting of many power stations is insufficient, it must also be recorded that in a great many of the stations constructed during the past two or three years considerable attention has been paid to lighting.

Old installations cannot be measured by a present-day scale since the demand for light has increased within the last few years in an unprecedented way, especially since the gas-filled lighting unit has been placed on the market. In what follows here a brief review of the reasons for some of the shortcomings in power-house illumination, wherever such shortcomings appear, is presented, together with details of types of installations that have been found suitable for lighting different parts of a station and its apparatus.

The lack of suitable fixtures for power-station lighting has been a serious handicap in working out station illuminating problems. A lighting fixture in a power plant is usually considered a necessary evil, since it is a type of equipment which is only used at night and is a nuisance in the daytime. Probably because the demand for power-house fixtures is so small, as compared with the demand for residence, store and street fixtures, the manufacturers have not developed designs which are directly adaptable for power-house use. The existing fixtures are largely for street use and not directly suitable for connecting to conduit systems, or they are house fixtures, both too fancy and too flimsy for power-house lighting. As will be seen later, this difficulty can easily be overcome by proper adaptation.

Power houses are generally high and wide, which makes the mounting of overhead as well as of bracket fixtures difficult. Cranes, steam pipes and other obstructions add to this difficulty. Engineers in charge of the design and those in charge of the construction of a power house are continually confronted by difficult problems which seem more important than the illumination, and the lighting is generally left until the construction is well advanced when everybody is kept busy preparing to start generators to supply power on a promised date. Therefore, not much attention is paid to lighting under such circumstances, and the "cobbler's children" are not only a very good comparison, but also a real excuse. Switchboard operators, for some mysterious reason known only to them, do not like much light. In some cases known to the writer it was necessary to give the operator strict instructions to keep lamps on under the penalty of being discharged.

The tendency in working out station lighting systems is largely the same as in any other illumination problem, namely, to approach daylight; to use general instead of individual illumination wherever possible, and to place fixtures as far as possible out of the direct line of vision.

With modern high-wattage, gas-filled lamps, overhead general illumination is possible in most cases. Most power houses have a crane, and fixtures can be placed high between or below the roof trusses, so that they can be reached from the crane. With the proper selection of reflectors, a nearly uniform distribution

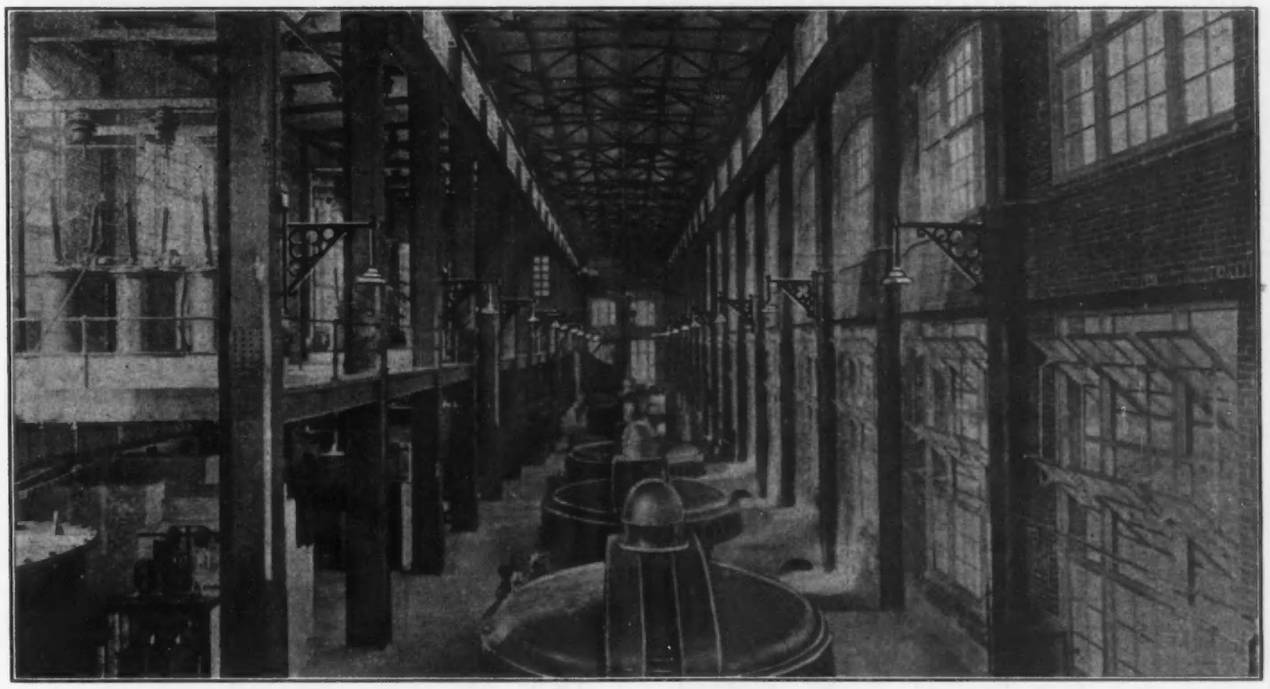


FIG. 1—STATION OF PARR SHOALS (S. C.) POWER COMPANY; SHOWING USE OF BRACKET FIXTURES WITH THREE 100-WATT TUNGSTEN LAMPS IN 18-IN. METAL REFLECTORS 24 FT. ABOVE FLOOR AND 30 FT. APART; 2.55-FT. CANDLES ILLUMINATION SECURED

can be obtained without great difficulty. The recommendation of the N. E. L. A. of 2.5 foot-candles intensity for power houses can be considered as ample. However, it must not be forgotten that reflectors and lamps will be covered with dust and that the attendant will not always have or take time to keep them clean. From 15 per cent to 25 per cent should, therefore, be allowed to account for this probable reduction in the efficiency of the lighting unit. In order to illustrate the use of overhead lighting, a typical power-house building is shown with a suitable arrangement of lamps.

In Fig. 4 is shown a layout for general illumination using a lamp and reflector whose photometric curve is shown in Fig. 5. Curves of light distribution in foot-candles at various places on a horizontal plane of illumination 3 ft. 6 in. above the floor line are also shown. It will be seen that the variation in intensity is relatively small and that the average is about 2.5 foot-candles, which may be considered good illumination for a power station. The only difficulty in such an installation is due to the fact that the fixtures have to be suspended from the purlins instead of from the trusses or the cross-braces between the trusses. If a 0.75-in. or 1-in. pipe is used for the installations, however, this can hardly be considered a difficulty.

Curves such as are shown in Fig. 4 can easily be derived from photometric curves such as shown in Fig. 5 by the aid of the tables given in Bulletin No. 20 of the engineering department of National Lamp Works of the General Electric Company.

A method of suspending heavy overhead fixtures is shown in Fig. 9. Since fixture wire should not be used for lamps rated at 200 watts and above, slow-burning wire is recommended run inside the fixture stems. A switch should be provided for each large fixture at a suitable place, so that lighting units may be turned off when a particular part of the station is not in use.

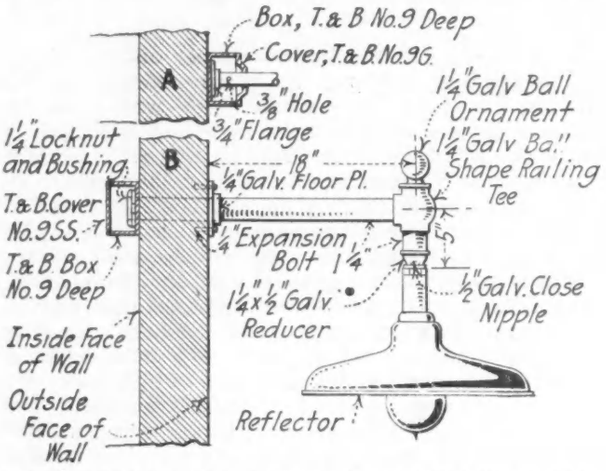

Box, T. & B. No. 9 Deep
Cover, T. & B. No. 96
A
B
3/8" Hole
3/4" Flange
1 1/4" Galv Ball Ornament
1 1/4" Galv Ba." Shape Railing Tee
1 1/4" Locknut and Bushing
18"
1/4" Galv. Floor Pl.
T. & B. Cover No. 955
T. & B. Box No. 9 Deep
1/4" Expansion Bolt 1 1/4"
5"
1 1/4" x 1/2" Galv. Reducer
1/2" Galv. Close Nipple
Inside Face of Wall
Outside Face of Wall
Reflector

FIG. 2—OUTDOOR FIXTURE FOR POWER STATION ENTRANCE DESIGNED FOR CONNECTION TO CONDUIT SYSTEM

This fixture is made up of 1¼-in. standard pipe fittings. At *A* is shown a method of mounting a similar fixture indoors made up of ¾-in. pipe. A standard ¾-in. flange will fit inside a standard 4-in. round conduit box as shown.

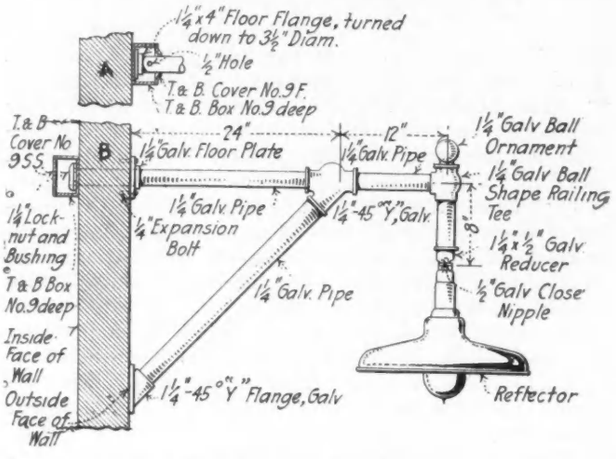

1 1/4" x 4" Floor Flange, turned down to 3 1/2" Diam.
A
1/2" Hole
T. & B. Cover No. 9 F.
T. & B. Box No. 9 deep
B
T. & B. Cover No. 955
24"
1/4" Galv. Floor Plate
12"
1/4" Galv. Pipe
1 1/4" Galv Ball Ornament
1 1/4" Galv Ball Shape Railing Tee
1/4" Galv. Pipe
1/4" Expansion Bolt
1/4" 45° "Y" Galv.
8"
1 1/4" x 1/2" Galv. Reducer
1/2" Galv Close Nipple
1/4" Galv. Pipe
1 1/4" 45° "Y" Flange, Galv
Reflector

FIG. 3—LARGE FIXTURE FOR OUTDOOR MOUNTING OVER POWER STATION ENTRANCE

This fixture is made up of standard 1¼-in. pipe fittings and can be made to extend a considerable distance from the wall. *A* shows mounting of same fixture indoors. A 1¼-in. standard pipe flange can be turned down to fit inside a 4-in. round box.

The conduit runs and wiring for an installation such as illustrated here are very simple and the cost of installation as well as of operation is relatively low.

In some cases it will be impossible to do away with bracket fixtures altogether. When large bracket fixtures are required, they should be so arranged that they can be turned out of the way to permit a crane to pass. Such a fixture is shown in Fig. 8, in which all wiring is inclosed. Smaller bracket fixtures can be made up of standard pipe fittings, as shown in Figs. 2 and 3. These fixtures can be easily made up on the job, and are substantial, make a strong and pleasing appearance and are more suitable for power-house use than are flimsy goosenecks or similar fixtures.

The same method can be adapted for fixtures to be placed out of doors, over doorways and connected to the indoor conduit system, as shown in Figs. 2 and 3.

Both the front and back of a switchboard should be well illuminated. In most cases the general illumination will take care of this and no special lighting will be required. Whenever special switchboard lighting must be installed, a trough reflector held at a proper distance from the switchboard should be used with either Johns-

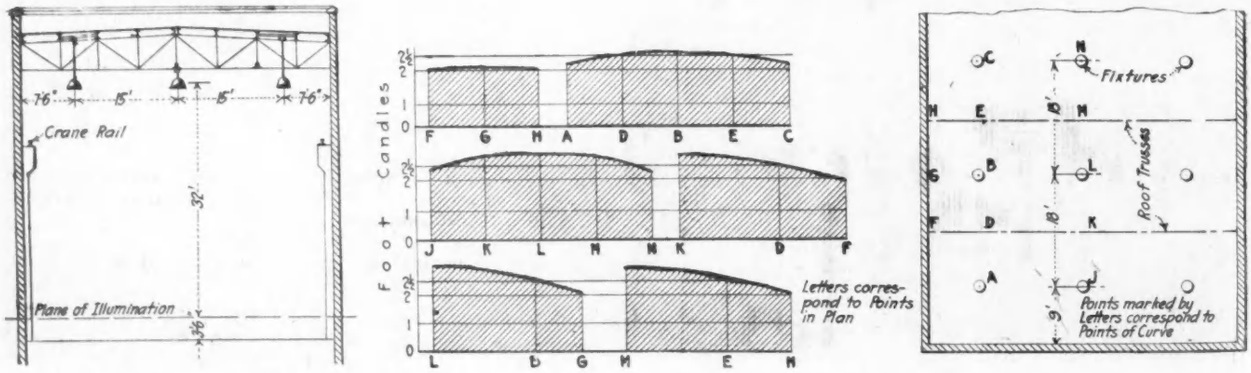


FIG. 4—TYPICAL POWER STATION LIGHTING LAYOUT WITH LAMPS MOUNTED OVERHEAD AND PROVIDING UNIFORM DISTRIBUTION OF LIGHT ON A PLANE 3.6 FT. ABOVE FLOOR LINE. THE CENTER FIXTURE IS MOUNTED ON CROSS BRACING BETWEEN TRUSSES AND SIDE FIXTURES SUSPENDED FROM ROOF PURLINS

Manville "Linolite" lighting units and reflectors or standard 10-watt tungsten units with suitable reflectors. An easy method of supporting the shade without giving it a clumsy appearance is shown in Fig. 7. The switchboard pipe supports are extended up and the shade is bracket supported therefrom. A small hole in one of the pipes will let the wires pass into the shade.

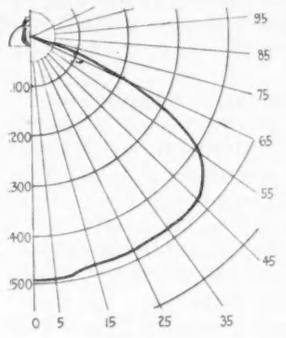


FIG. 5

Curve of light distribution for a 200-watt gas-filled lamp in a metal reflector 8.25 in. in diameter, on which curves in Fig. 4 are based.

In general the problem of switchboard illumination is about the same as that of lighting paintings in art galleries, with the only difference that a painting requires the same amount of light over its whole height, while a switchboard requires more light at its upper part where the instruments are mounted.

The rear of the switchboard will be best illuminated by small brackets on the back wall, or by small overhead fixtures suspended from the tie rods. Frosted lamps will be found more satisfactory in the back of the switchboard as it is installed in the average power station than are clear lamps.

Whenever an emergency source, such as a control battery, is available, a small lever switch equipped with a low-voltage relay, which will turn on an emergency circuit automatically in case the main source of light should fail, should be installed on the switchboard. Such an emergency circuit can be extended over the entire power house. In most power houses the whole lighting system can be thrown on the exciter bus, and in this case it will only be necessary to install emergency lamps near the switchboard, so that the operator can see to shift the double-throw switch over to the exciter bus.

Overhead fixtures are recommended for storage-battery rooms. They should be substantial in construction and vaporproof. Such a fixture is shown in Fig. 9, made up with V. V. fittings No. 52,188 or No. 52,198 or Benjamin fittings No. 630 or No. 1568, the latter being preferable for a 200-watt lamp. Any other substantial vaporproof fixture will, however, be satisfactory.

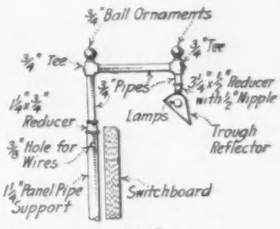


FIG. 7

Method of mounting trough reflectors for switchboards on panel pipe supports.

General and uniform illumination will, as a rule, be impossible in high-tension rooms. However, disconnecting switches, oil switches and other apparatus should be thoroughly illuminated. It will often be necessary to omit shades and reflectors altogether, and in such cases frosted lamps should be used. Wire guards are to be strongly recommended for all lamps. Fixtures should be so placed in high-tension rooms that the man exchanging lamps cannot come in contact with any energized parts. For dark high-tension rooms a switch should be provided outside the high-tension room so that the light can be turned on before entering the room. When lightning arresters are mounted on the roof, fixtures can easily be attached to the pipe framework of the arrester. A switch should be placed indoors near the ladder or stairs leading to the roof. A pilot lamp can be provided near this switch to tell the operator when the lights on the roof are on.

The general principle of turbine and engine-room lighting can also be applied to boiler rooms. Overhead lighting, however, will very seldom be advisable since the spaces to be lighted are generally not very wide compared with their height. Bracket fixtures such as shown in Figs. 2A and 3A will give good service. Slow-burning wire instead of rubber-covered wire should be used in all hot places.

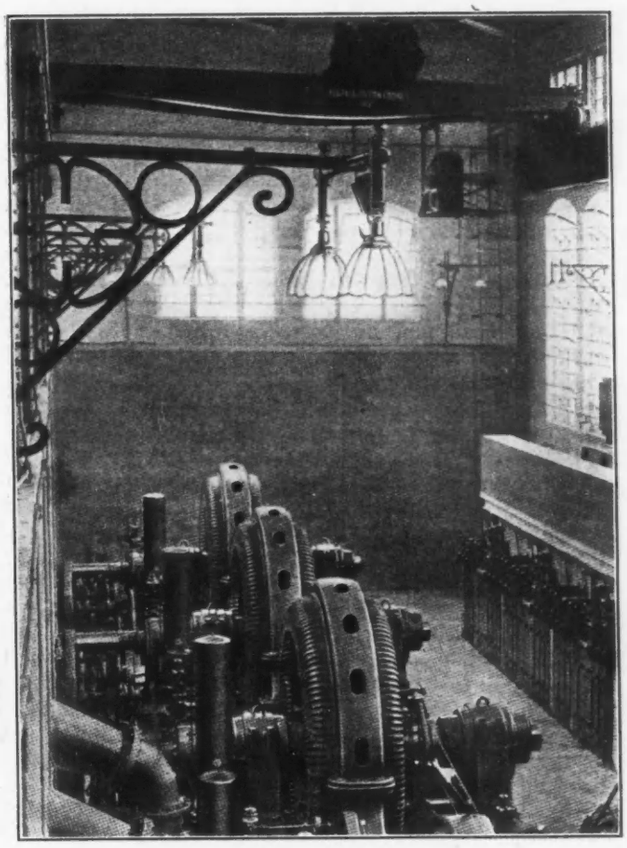


FIG. 6—OCOEE NO. 1 STATION OF EASTERN TENNESSEE POWER COMPANY

This illustration shows the use of bracket fixtures with two glass reflectors instead of one large metal shade.

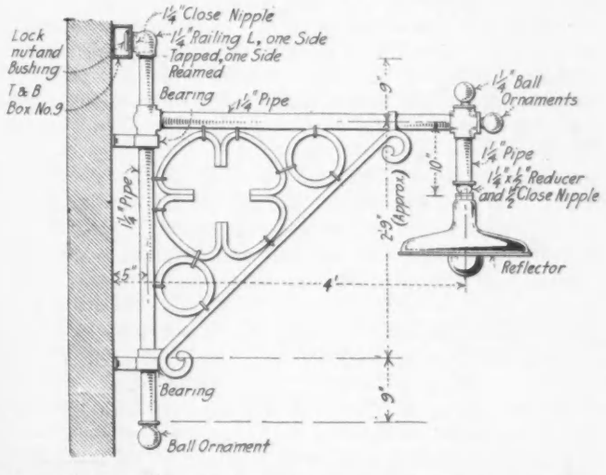


FIG. 8 — LARGE BRACKET FIXTURE FOR WALL MOUNTING ARRANGED TO PERMIT TURNING OUT OF WAY OF CRANE—ALL WIRING IS INCLOSED

Wherever possible steam gages should have illuminated dials, with the lamp inside the case. Where non-illuminated dials are used, a 45-deg. shade above the gage should be installed for each gage. No rules can be given for the horizontal and vertical distance of the lamp from the gage. This depends on the height of the

gage over the floor and also on other sources of light in the neighborhood.

For vertical tubular gages, such as water or vacuum instruments, the lamp should neither be placed above nor in front of the gage, nor behind it. A tubular lamp, preferably frosted, with a proper longitudinal shade placed at one side of the gage will usually give best results.

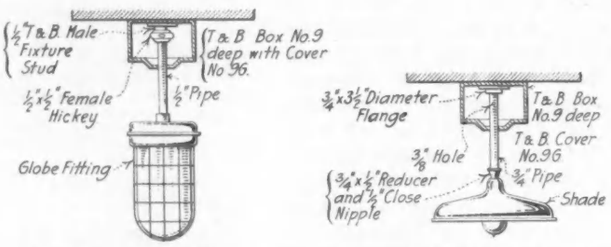

½" T & B. Male Fixture Stud
T & B Box No. 9 deep with Cover No. 96.
½" x ½" Female Hickey
½" Pipe
Globe Fitting
¾" x 3½" Diameter Flange
T & B Box No. 9 deep
T & B. Cover No. 96
⅜" Hole
¾" x ½" Reducer and ½" Close Nipple
¾" Pipe
Shade

FIG. 9—FIXTURE ADAPTED FOR BATTERY ROOM USE AND A METHOD OF SUSPENDING HEAVY REFLECTORS

No hickeys are used and a standard pipe flange is mounted inside of round box as shown.

All switch cabinets should be made of heavy iron and have double-pole lever switches for all circuits. Switch handles should be of the spade type with a button on the front. It should be remembered that these switches will be used by men accustomed to handling heavy machinery. For this same reason snap switches should not be used in power houses. Push-button switches mounted in heavy iron boxes should be adopted instead.

Separate circuits should be run for attachment receptacles, so that it should not be necessary to turn on all the lights when a portable unit is to be used. At least one receptacle should be provided at each machine and at every place where close inspection may at any time become necessary. Ordinary house receptacles are not to be recommended for power houses or any industrial purpose.

There are several good, strong receptacles on the market which will serve the purpose, such as Russell & Stoll No. 455, which is provided with a trapdoor and is waterproof. Several portable units should be available at every power plant and should be of strong construction and have waterproof sockets, such as R & S No. 476. The only cord to be recommended for such a portable unit is deck cable. All other types of flexible cable will usually be found unsatisfactory.

The fixtures illustrated have been used in several installations designed by the J. G. White Engineering Corporation, 43 Exchange Place, New York City. The installations in Figs. 1 and 6 were designed before the introduction of the gas-filled lamp which in part accounts for the use of three 100-watt lamps in each of fixtures of Fig. 1.

Lubrication of Station and Industrial Machinery—II

Essential Characteristics of Commercial Lubricants for the Satisfactory Operation of Steam Turbines and Engines, Oil Engines, Ball and Roller Bearings, Rope and Chain Drives

BY DR. ARTHUR CURTIS SCOTT
Consulting Engineer, Dallas, Tex.

IN the first section of this article, which was published in the April 8 issue of the ELECTRICAL WORLD, practical considerations in securing satisfactory lubrication, analyzed according to the requirements of different types of bearing surfaces were discussed. In what follows here the essential characteristics of commercial lubricants for use with different types of machines are taken up.

Lubricants may be classified as liquid, semi-solid and solid. Liquid lubricants include water, under certain conditions, and oils. In accordance with their origin, oils may be vegetable, animal and mineral. Vegetable and animal oils, also termed fixed oils and fats, decompose at comparatively low temperatures, and differ from mineral oils in containing about 10 per cent of oxygen as an essential constituent. The distinction between fixed oils and fats is one of temperature only, fixed oils becoming fats at low temperatures and fats becoming oils at 150 deg. Fahr.

Mineral oils are produced from petroleum, or crude oil, which is obtained in various parts of the world, either issuing naturally from the ground or by boring. Crude oil has the general chemical formula, C_nH_{2n+2}, commonly designated as the paraffine series of hydrocarbons, and beginning with CH_4, or methane (gas), continues as C_2H_6, ethane (gas), C_3H_8, propane (gas), C_4H_{10}, butane (liquid at 1 deg. C., and normal barometric pressure), through a series of liquids to $C_{30}H_{62}$, which is a solid wax at ordinary temperatures—either paraffine or asphalt, which is the polymerized paraffine base. As liquid fractionations produced by heat or chemicals, or both, from the lighter to the heavier products we have cymogene, rhigolene, gasoline, benzine (not C_6H_6), naphtha, kerosene, intermediate or gas oil, light lubricating oils, and heavy lubricating oils. Under the higher temperatures, as for steam engine cylinders, an asphalt base oil tends to carbonize, while the paraffine base oil tends to "crack" into a lower order of paraffines, C_nH_{2n}, and will continue to act as a lubricant, when the carbon resulting from the decomposition of the asphalt base oil would not.

BLENDED OILS

Blended oils are combinations of mineral and fixed oils in a variety of proportions. In the early days of the use of mineral oils, they were looked upon as cheap and objectionable adulterants of lubricating oils. At the present time the tendency appears to be the reverse, and to regard the fixed oils as undesirable adulterants. As a matter of fact, however, for many bearing surfaces, a blended oil is economically and practically better than either a pure mineral oil or a pure fixed oil, because mineral oil is deficient in the greasy property common to most of the high-grade fixed oils, and is most efficient only with bath, ring or forced-feed lubrication, or at the higher temperatures which would decompose a fixed oil.

Fixed oils and fats are most satisfactory for high pressures, and pure mineral oils for pressures below 70 lb. per square inch, with copious lubrication and bearing surface materials which do not readily seize each other. In general it is desirable to make the proportion of

mineral oil to fixed oil large in any blend, and thereby reduce the drying and gumming property as much as possible. It may also be remarked that spontaneous combustion of saturated cotton waste is less likely to occur with a blend which is low in fixed oil content.

SEMI-SOLID LUBRICANTS AND GREASES

Semi-solid lubricants, or greases, are compounds of mineral oils, or fixed oils and fats, containing sufficient soap to make them plastic at ordinary and low temperatures. In considering the greasy property of lubricants herein referred to with respect to oils, it may be noted that vaseline represents a pure mineral oil grease and tallow a pure fixed-oil grease, but the latter is far more greasy than the former.

In some cases solid lubricants are advantageously added to greases to meet special requirements of low-speed and high-bearing pressure. Economy results from the use of greases, with ordinary bearing surfaces in general, only when the speed is relatively low. At moderate and high speeds the loss of power due to their use is quite prohibitive, although often underestimated.

Solid lubricants, such as graphite, soapstone and mica, and combinations of them, are used for heavy loads, low speeds, and restricted bearing surface area. Some bearing surfaces are provided with holes for receiving solid graphitic lubricants, which when properly placed lubricate the surfaces for a relatively long time without further attention.

Lubricant Characteristics.—Lubricants to be economical and efficient must themselves possess definite and reliable characteristics to meet the specific requirements of bearing surfaces properly designed with respect to materials, speed, load, area, pressure, temperature, and provided with proper distribution of the lubricant. The following properties should be given consideration.

1. Stability.
2. Viscosity.
3. Volatility.
4. Density.
5. Flash point.
6. Fire point.
7. Setting point.
8. Acidity.
9. Color.
10. Character of base, and carbon content.

Stability.—This term should comprehend primarily the general character of the oil, as to whether it is: A. A pure mineral oil. B. A mixture of mineral oils. C. A blend of mineral and fixed oils. D. A pure fixed oil.

Viscosity.—The viscosity of an oil at 100 deg. Fahr., the value commonly given, means little when considered for use in connection with high temperature bearing surfaces. With any standard "brand" of lubricating oil, should be furnished a curve showing the viscosity of the oil, for a range of temperatures within which it is presumed to be a satisfactory lubricant.

Volatility.—Evaporation without decomposition distinguishes the mineral, or hydrocarbon oils, from the fixed oils, but the temperature at which evaporation of a mineral oil occurs depends upon the nature of the hydrocarbons in it. For a mixed oil, of stability B, an increase in temperature may not only drive off the more volatile constituents, but act to change the general lubricating characteristics of the oil. Common machine oils evaporate scarcely at all at ordinary temperatures, but at the working temperatures of steam engine cylinders, and particularly of internal combustion engine cylinders, the evaporation of a lubricating oil may be so great as to deprive the oil of its lubricating qualities almost entirely.

Moreover, the density, flash point and viscosity of an oil do not afford reliable indices to its volatility. The writer has tested, for example, two standard grades of cylinder lubricating oil for volatility, by placing carefully weighed quantities of each in an oven which was subjected to a practically constant temperature of 340 deg. Fahr. for 1 hr. The viscosity and flash point values of each sample, as stated by the manufacturers, were practically identical. The density, as determined by a Westphal balance, for sample No. 1, was 0.9350, and for sample No. 2 it was 0.9300. The loss by evaporation for No. 1, was 4.0 per cent, and for No .2 it was only 2.6 per cent, which shows that in this instance the oil having the higher density lost over one and one-half times as much as the lighter oil. Sample No. 1 became very dark in color and was almost opaque after heating, while sample No. 2 darkened in color much less proportionately, and was still translucent.

An oil which evaporates to a serious extent at working temperature is obviously an inefficient and expensive lubricant, since the evaporation of a part may leave behind a viscid or dry residue upon the bearing surface. It is believed by the writer that this property is of such importance with reference to high temperature lubrication that it merits more than the ordinary amount of attention given to it by lubricant dealers. In order that this characteristic of any given "brand" of oil may be correctly interpreted, a test curve of volatility should be available to show the loss by evaporation at various temperatures over a range of from 32 deg. Fahr. to 500 deg. Fahr.

Density.—The density of animal and vegetable oils at 60 deg. Fahr. varies over a range of about 0.879 for sperm oil, to about 0.968 for castor oil; for mineral oils, from about 0.860 to 0.940; for rosin oils, 0.960 to 1.00; and for heavy coal-tar oils, over 1.00. The density is of only secondary importance, in so far as lubricating qualities are concerned, but may serve somewhat as an index to the general character and stability of the oil. It would appear desirable, however, that the density should be stated definitely in figures as the specific gravity at a given temperature, rather than as "about (so many) degrees Beaumé," as is commonly done. The pyknometer is a decidedly more accurate instrument for determinations in general than the hydrometer.

Flash Point—Fire Point.—All mineral oils give off vapor when sufficiently heated, and the temperature at which the application of a flame will cause a miniature flash, in an open vessel, is termed the "flash point." The temperature at which the vapor is sufficient to maintain a continuous flame is termed the "fire point" or burning point. Fixed oils act differently—no oil vapor is given off on heating, until they begin to decompose, and the flash point of the destructive distillation products is high (about 400 deg. Fahr.).

The flash point of a cylinder oil has been considered by some to be an important index to its lubricative qualities, with the notion in mind that it indicates the volatility of this oil The notion, however, is an erroneous one, as there is no necessary relation between the flash point and volatility of such oils, and the writer considers that values given for flash point and fire point of a cylinder lubricating oil are of but little consequence, and are likely to be more or less misleading to the user unless they be supplemented with a definite value for volatility at the working temperature of the cylinder.

Setting Point.—The setting point of lubricating oils is unlike the congealing temperatures of simple liquids like water, alcohol, glycerine, etc., because a lubricating oil is a mixture of constituents having independent melting points. Hence we note that sperm oil deposits spermaceti; lard oil deposits fat, and some mineral oils deposit paraffine, before the mixture as a whole congeals. The "setting point," therefore, may be regarded either as the temperature at which the separation of solids begins, or the temperature at which the oil ceases to flow. In general, the latter temperature is considered to be the setting point, as many oils do not deposit solids, or are too opaque for deposits to be readily observed. This property of a lubricating oil is important chiefly in connection with refrigerating machinery, and especially low-temperature bearing surfaces.

Acidity.—Free acid in a lubricant, whether it be a mineral acid, like nitric or sulphuric; an organic acid, naturally existing in crude oil; a rosin acid, or a fatty acid, is objectionable because of its possible corrosive action on bearing surfaces. Experience shows that unrefined mineral oils which contain usually a small percentage (0.1 per cent to 2 per cent) of weak organic acids, commonly calculated as oleic acid, and oils containing a small amount of free fatty acid, also calculated as oleic acid, are not likely to be injurious to common bearing surfaces. Properly refined pale mineral oils are almost perfectly neutral.

Color.—This characteristic of a lubricating oil is only of secondary importance, in general, as it gives only a slight indication as to lubricating quality. Some oils, as lard oil, are practically colorless, while most oils are decidedly tinted red, yellow, green, brown, etc., and they frequently present a different color by reflected than by transmitted light. Fixed oils and refined mineral oils are translucent, while unrefined mineral oils are usually opaque, and commonly are fluorescent.

Character of Base.—Whether a mineral oil be a paraffine base, or an asphalt base oil, is significant only for certain types of cylinder lubrication. For high pressure steam cylinders an asphalt base oil is unsatisfactory, because of its tendency to carbonize under conditions that a paraffine base oil would not. For the high temperatures of internal combustion engine cylinders a lubricating oil of low carbon content is obviously essential.

STEAM TURBINE LUBRICATION

The bearings of a steam turbine are lubricated necessarily by a system of forced feed. The temperature of bearings is above that for those of average machinery, and because of the high speed the operator has no time to doctor a "hot" bearing before it would seize, even though he detected a condition of insufficient lubrication. Here the characteristics of stability, viscosity, volatility and acidity, are of prime importance. To be economically serviceable, the oil should be of stability A, or a pure mineral oil, of low volatility at the working temperature, of proper viscosity for the working temperature of low carbon content and of zero acidity.

STEAM ENGINE CYLINDER LUBRICATION

It is practically impossible to so lubricate steam cylinders as to reduce the friction and wear of the bearing surfaces to that of well-lubricated journals. The pistons and valves, in moving with a reciprocating motion, do not as effectively trap the oil between the surfaces as do rotating shafts, and it is also impracticable to flood the surfaces with oil. Since the lubricant is commonly introduced with the steam it must act in a subdivided state in the presence of water, and an elevated temperature in accordance with the steam pressure.

Fixed oils are entirely unsuitable, because they decompose and set free fatty acids which are corrosive. Only a pure or mixed mineral oil is efficient and economical, and the proper viscosity and volatility values, which are the most important characteristics, are governed primarily by the steam pressure and secondarily by the speed and type of engine, whether condensing or non-

condensing. The "stock" used in a steam cylinder lubricating oil should be paraffine base, for reasons heretofore mentioned. The volatility at the working temperature should be low, since the higher temperature tends to vaporize the oil, and the vapor is readily rejected with the exhaust steam. In the case of condensing engines this waste is augmented by the necessary expense of removing the oil from the water returned to the boiler. Experience has shown that a perforated oil inlet pipe extending the entire diameter of the steam pipe is most satisfactory for economical lubrication. It has also been found serviceable, in large horizontal engines having cylinders 24 in. in diameter and over, to introduce a part of the lubricating oil at one or more points on the lower half of the cylinder by means of a supplementary forced-feed lubricator.

Internal Combustion Engine Cylinder Lubrication

In the operation of the gas engine and various types of oil engines the cylinder temperatures are relatively high, and especially so in the Diesel type crude-oil engine. The lubricant has the advantage of no water to contend with, as in the steam cylinder. It has the decided disadvantage, however, not only of higher temperature, but, in large size units, of high piston speed, as compared with that of steam engines having a corresponding cylinder bore and about the same power at nominal cut-off. For example, a Hamilton-Corliss engine, 20 in. and 40 in. by 48 in., has a piston speed of 720 ft. per minute; a Bates-Corliss, 18 in. and 38 in. by 48 in., 720 ft. per minute; a Hardy-Tynes, 21 in. and 42 in. by 42 in., 630 ft. per minute; a Harrisburg four-valve, 17 in. and 32 in. by 20 in., 520 ft. per minute. These may be compared with a Busch-Sulzer crude-oil engine, 19 in. by 24½ in., with a piston speed of 816 ft. per minute; a McIntosh-Seymour, 18⅞ in. by 28⅜ in., 750 ft. per minute; a Lyons-Atlas, 21 in. by 30 in., 900 ft. per minute; an Allis-Chalmers, 18 in. by 27 in., 900 ft. per minute, and a Snow, 20 in. by 33 in. 902 ft. per minute.

It is at once evident that to meet the requirements of economical lubrication of crude oil engine cylinders, especially under variable load conditions, wherein the crude oil engine far surpasses the over-all economy of the smaller sizes of steam-driven units, it is necessary to carefully correlate the design of the lubricating system with respect to distribution of the lubricant, with the vital characteristics of such lubricating oil as can be procured for the service.

In the first place the service requires, necessarily, that the oil shall be as nearly as possible non-volatile, and that it shall possess a high viscosity, at the working temperature, and shall be of low carbon content. Such requirements at once place it in stability A. division, as only a pure mineral oil can be used economically. One leading oil manufacturer has produced a pure mineral oil, with a viscosity at 100 deg. Fahr., of 750 (Saybolt), which is high. No data are at hand showing the important features of this oil, its viscosity at working temperature nor its volatility at working temperature. Of course, the flash point, density and other characteristics are available, but as an indication of the quality of this oil as an internal combustion engine cylinder lubricant, they are only of passing significance.

In the second place, a lack of proper distribution of the lubricant upon the cylinder surface cannot be compensated for by any oil, however high it may stand in the scale of physical and chemical characteristics.

Low Temperature Lubrication

In the operation of refrigerating machinery, where the temperature is below the average for most bearing surfaces, a lubricant of stability A. or B. is most economical, because solids are not deposited before the "setting point" is reached, and particularly because neutral mineral oils are not corrosive, and are not affected by ammonia and other chemicals used in low temperature work. Oils for this purpose should have a proper viscosity at the working temperature, should be acid free, and have a "setting point" below 10 deg. Fahr., as characteristics of chief importance.

Ball and Roller-Bearing Lubrication

The main feature which differentiates these bearings from sliding surface bearings is found in the frictional coefficient. The friction of a ball bearing is practically independent of the speed, temperature and of the viscosity of the lubricant. It varies directly as the load and the static coefficient of friction is but slightly greater than the kinetic coefficient. The prime requisites of a lubricant for such bearings is freedom from acid and effectiveness in the prevention of oxidation, or rust. A pure mineral oil grease, like vaseline, is most serviceable and economical for moderate loads and temperatures. For heavy loads and higher temperatures the bearing should be constantly submerged in oil. It should be noted that in case of pitting or corrosion of one or more of the balls in a bearing due to the acid in the lubricant, or possible oxidation of the surface by exposure to air and moisture, will necessitate the replacement of the entire bearing with a new one, if it be a relatively large bearing.

Lubrication of Rope and Chain Drives

Transmission of power by wire rope, cotton and hemp ropes, and by chains and gears, involves the use of lubricants. Linseed oil has been found to be one of the best preservatives of wire driving rope. For cotton and hemp ropes a satisfactory lubricant is compounded of saponified tallow and graphite, the same being well worked into the rope in operation.

The characteristics of a lubricant for chain drives are governed largely by the temperature and the speed. For a high temperature the viscosity should be relatively high, and for high speed a light oil which will penetrate the joints is preferable. The lubricant should be applied on the inner side of the chain, and thereby advantage taken of the centrifugal force due to speed to cause it to reach the wearing surfaces. A chain drive should be protected, if possible, with a dustproof and gritproof case, as its durability is thereby greatly increased.

The lubrication of large iron gears, both for reducing friction and the amount of noise in running, is best accomplished by a graphitic grease which is so compounded as to be more than normally adhesive in character. Of course, the more "sticky" the compound the more power will be lost in friction, but a slight increase in friction is ordinarily more than compensated for by quiet running.

Lubricant Specifications

It should be possible to purchase lubricants for all purposes under specifications, as it is possible to purchase fuel. That it is difficult to do so at the present time, however, is well understood. The requirements which appear principally to be needed in this connection, are: (1) A classification of lubricant service; (2) A definite statement of the actual characteristics of "brands" of lubricants on the market, and (3) An exposition of economical lubricating oil filtering and oil recovery methods, for central stations, and industrial manufacturing establishments.

This article will be followed by one taking up important considerations in handling, filtering and recovering oil in an early issue.

Electrical Precipitation of Smoke and Dust

Experiments in the Electrical Precipitation of Various Materials in Suspension—Constructing and Operating Problems in the Design of a Suitable Treater

BY HALBERT P. HILL

ELECTRICAL precipitation has proved an effective method for obviating smoke and dust and for the recovery of solids suspended in gases. While the method has been installed with considerable success for various purposes, the proper size and class of apparatus to be used has been determined more or less by experiment, and there still exists a wide difference of opinion on the best arrangements to satisfy the requirements. The ideal method of electrical precipitation would be to utilize a high voltage, as generated from a static machine, but unfortunately this form of apparatus is not dependable nor has it been possible to build it of sufficient rating. Experimenters have had to content themselves, therefore, with other means of securing high voltages of direct current.

The writer has conducted a number of experiments under many varying conditions on various materials to determine the most practical ways of making electrical precipitation effective. The first apparatus used consisted of a 7.5-kw. motor-generator set operated from 220 volts direct current, generating alternating current at 154 volts, sixty cycles, single-phase. This unit was connected to a transformer with primaries arranged with six taps so that secondary voltages of 40,000, 50,000, 60,000, 70,000, 80,000 and 100,000 were available. In order to get a finer adjustment a variable resistance was connected between the taps so that it was possible to secure voltages in 1000-volt steps from 40,000 volts to 100,000 volts, and ratings from 2.5 kw. to 7.5 kw. The secondary of this transformer was connected to a rotary rectifying switch which rectified the current into a pulsating unidirectional current. From the switch the high-tension wires were carried to the treater. Since the experiments were being conducted on relatively cold gases, at a temperature seldom exceeding 200 deg., a wood box 8 ft. long, 6 ft. wide and 4 ft. deep was used, in which wooden frames covered with copper screens of No. 100 mesh were mounted. There were six screens and all were connected to the ground. An insulated frame was provided at each end, and between each screen three piano wires were so spaced that they were 10 in. from each screen and 10 in. apart. All these wires were connected together and formed the positive pole.

This treater was used in conjunction with an atomizing house, where fluids containing solids, such as milk, salt solution and various chemicals, were atomized. By applying heat and spraying the solution in the room a large percentage of the solids would fall to the floor as a powder, but from 15 to 20 per cent was carried off in the exit gases. Various mechanical means for the recovery of the solids carried away in suspension were tried, but the electric treater was found the most effective and dependable. Serious difficulties were encountered at first with the treater, as long sprays of the product would build up and cause the treater to arc.

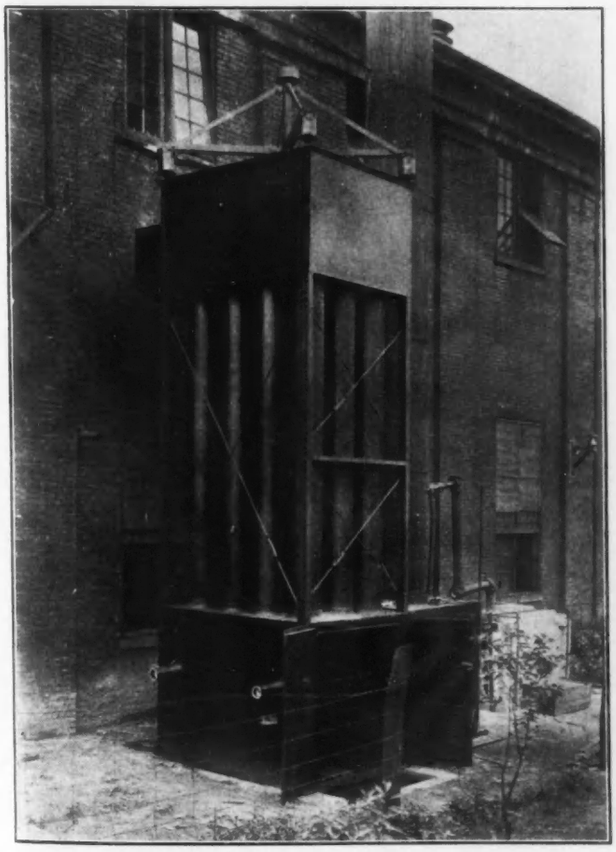


FIG. 1—A FORM OF SMOKE TREATER SIMILAR TO APPARATUS USED AT TESTING PLANT BUREAU OF MINES, PITTSBURGH, PA.

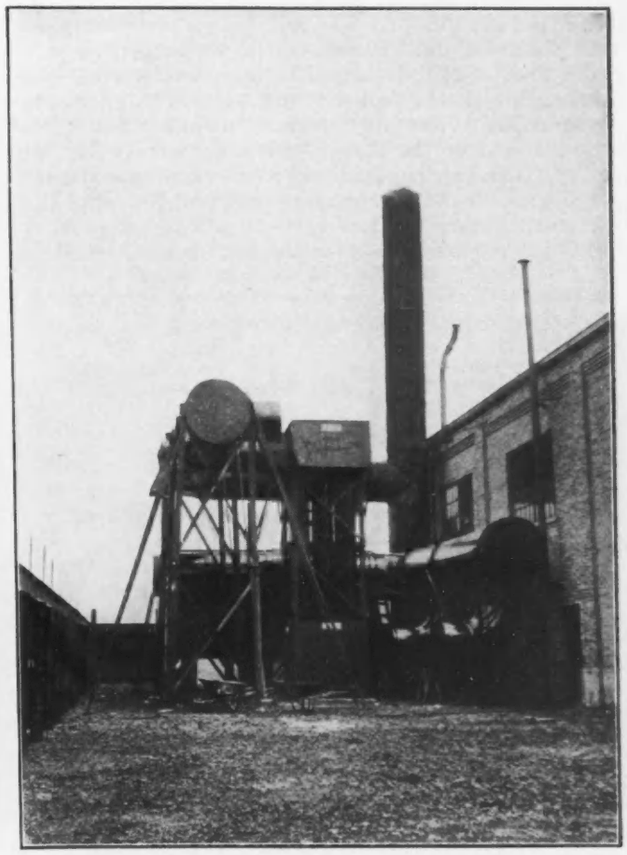


FIG. 2—TREATER AT EAST CHICAGO PLANT OF GOLDSCHMIDT DETINNING COMPANY FOR RECOVERING TIN IN RETORT GASES

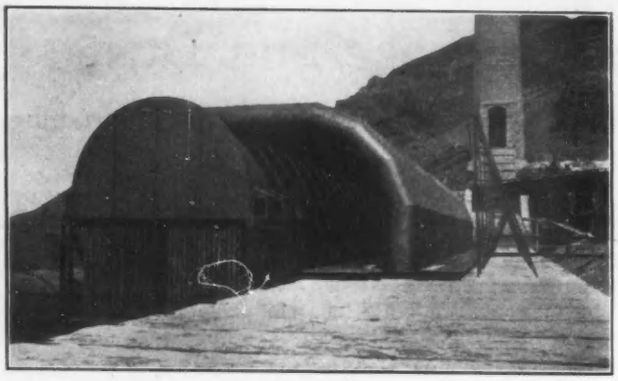


FIG. 3—TREATER AT GARFIELD SMELTER COMPANY'S PLANT, GARFIELD, UTAH, ONE OF THE LARGEST IN OPERATION

Mechanical means for shaking the screens were provided which proved quite effective. Another difficulty was encountered in building a transformer that was dependable for the service, as the end coils would gradually disintegrate owing to corona. It was only after numerous experiments that we were able to correct this difficulty. The first experiment was conducted with a disk switch having four contacts 90 deg. apart with one strap connecting the top and right-hand stud and a second strap connecting the bottom and left-hand stud. In front of these two studs a second disk was mounted with four contact shoes each about 10 deg. long, and to the top and bottom studs were connected the high-tension secondaries from the transformer. The right-hand and left-hand studs were connected to the treater. The right-hand stud, being positive, was connected to the positive wires, with the negative left-hand stud connected to the screen or ground.

With switches of this character, as well as two -arm and four-arm rectifier switches, in the beginning only 10 per cent of the wave was rectified. Finally the shoes were increased until 70 per cent of the wave was rectified. Trouble still developed in the transformers, however, caused by the fact that the treaters had high-condenser capacity, and the current commutated arced from the rotor arm to the shoe so that a high frequency was set up. The experiments seemed to show that the longer the arc or the greater the portion of the wave that was commutated the less current it was necessary to use to get good results on the treater. As an illustration, when handling 80,000 cu. ft. of vapor containing about 15 per cent of milk powders and solutions 50 milliamp. at 70,000 volts was used with a switch having shoes commutating 10 per cent of the arc. When these shoes were increased to 60 deg. it was possible to operate with 50,000 volts and about 35 milliamp. Afterward a switch was substituted consisting of two disks with two copper selectors bolted to the sides, the selectors being 80 deg. each, and four brushes made of hack-saw blades resting on glass plates. The plates were 22 in. in diameter and ¼ in. thick, and were mounted on aluminum quills. These were slid over a wooden shaft and the whole mounted in a cast-iron frame and the brushes supported on condensite tubes. This made a positive contact switch commutating 80 deg. of the wave. There was very little sparking, as the break occurred 5 deg. in advance of the zero line and the voltage was quite low at this point. It was found that more of the product could be handled by the treater with 27 milliamp. and 40,000 volts and this type of switch than with a make-and-break switch using practically twice the electrical energy. Using this type of switch, corona on the transformer was practically eliminated.

Tests were conducted to determine the actual advantages of using a positive contact switch. It was found that the frequency was over 350,000 oscillations when using the make-and-break switch commutating 10 deg. of the arc, and when using the positive contact switch commutating 80 deg. of the arc that the frequency dropped to about 40,000 oscillations. The results of the experiments seemed to prove that the ideal method would be to employ static machines. They, of course, could only be used in very small plants owing to their limited capacity and the uncertainty of operation in damp weather. The next approach to static machines is the positive-contact switch and a forty-cycle to sixty-cycle source of supply. The writer believes it a mistake to commutate only the apex of the wave and also a mistake to use too low a frequency. Assume that a given weight of materials passing through a treater at a given velocity is attracted by a certain force and a certain number of times per second, always bearing the fact in mind that when the contact at the switch is broken the treater charges and discharges and the velocity of materials must necessarily

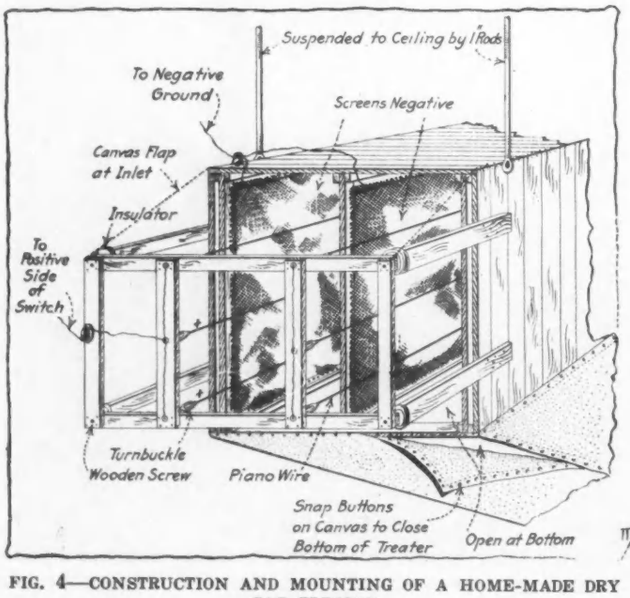


FIG. 4—CONSTRUCTION AND MOUNTING OF A HOME-MADE DRY GAS TREATER

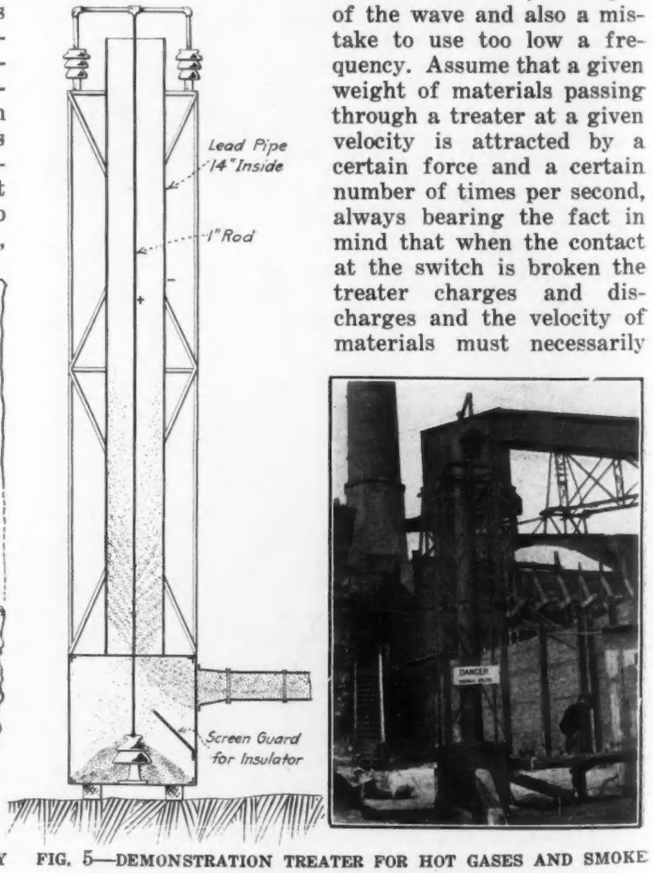


FIG. 5—DEMONSTRATION TREATER FOR HOT GASES AND SMOKE AND SECTION THROUGH SAME

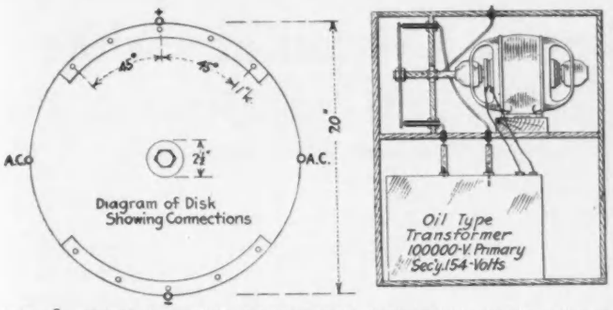


FIG. 6—TYPICAL SMALL RECTIFYING OUTFIT SHOWING MOUNTING OF ROTARY CONVERTER, RECTIFYING SWITCH AND TRANSFORMER

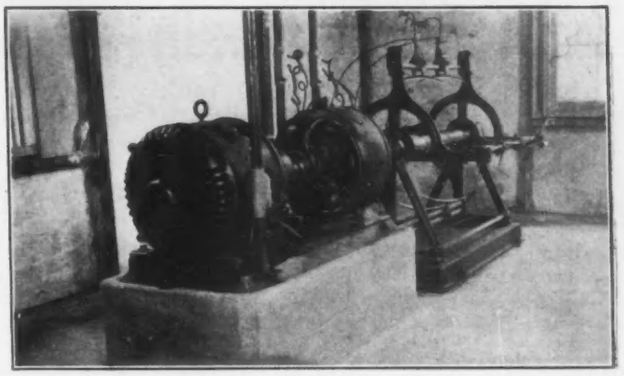


FIG. 8—MOTOR-DRIVEN SELF-EXCITED ALTERNATOR AND HIGH TENSION RECTIFYING SWITCH

This outfit consists of a 15-hp., 3-phase, 60-cycle, 1800-r.p.m. induction motor driving a 10-kva, 110-volt, 60-cycle single-phase self-excited generator. The rectifying switch at the right is of the two-arm type designed for 150,000 volts and for rectifying 40 per cent of a 60-cycle alternating current wave. The two contact arms shown are mounted on a Bakelite shaft and rotate in front of copper shoes. These shoes are adjustable to compensate for sparking due to leading current caused by electrostatic capacity of treater.

be retarded a certain percentage because of the discharge of the treater. Therefore, with the positive-contact switch the materials passing through the treater take on a charge, or each particle stores up a certain kinetic energy which will carry it a fixed distance, so that the nearer a true direct current or a uniform positive charge can be applied to the substance in suspension the greater attraction will be imparted to each particle and a more perfect precipitation secured.

A number of experiments have also been conducted on tube-type treaters, laying them flat and passing the gases through them at a fixed velocity; standing them on end and admitting gases through the bottom, and standing them on end and admitting gases at the top. The best results were obtained when the gases were admitted at the top, as the weight of the material as well as the momentum imparted by the velocity tended to deposit it in the bottom of the chamber or the treater. Experiments were conducted operating the apparatus at various frequencies from twenty-five cycles to a hundred cycles, and while at the higher frequency better results were obtained, for commercial efficiency, forty to sixty cycles was deemed best, as this allowed a speed of 1200 at forty cycles for the switch and 1800 at sixty cycles. The size of the transformers and the cost of the apparatus is in favor of the sixty-cycle equipment.

The size of the treater and the proportioning of the positive and negative elements are important considerations. Owing to the extremely large condenser effect of the treaters, great care should be exercised in the designing of a transformer to operate in connection with them. The windings should be protected with mica insulation, and as each end of the transformer is alternately grounded at every alternation extreme care should be taken in insulating the coils from the core. The best design of transformer seems to be a square magnetic circuit with a primary wound in the bottom and a secondary in the top. The secondary should be divided into at least four coils and should be spaced at least 6 in. apart and well insulated with oil. All the transformers used by the writer were put up in steel cases, with the terminals 17 in. apart. The 5-kw. and 7.5-kw. sizes were designed for continuous operation at 40 deg. rise in temperature. Owing to the length of the magnetic core and spacing of the coils to get proper insulation, there is considerable leakage in these transformers, which, however, is not an objectionable feature, as there are frequent short-circuits in the treaters, and this leakage is an advantage during periods of short-circuits.

A peculiar condition that the writer has never satisfactorily accounted for is that the insulation on the alternator seems to break down, particularly on the collector rings, and for no apparent reason. After operating a rectifier with a positive-contact switch this trouble seems to have been eliminated.

The field for electric precipitation is very large. The apparatus can be successfully used for abating smoke nuisance, provides an ideal means of removing the soot, clinker and ash in blast-furnace gas, which is so objectionable when used with gas engines, and may be used in cement mills and in conjunction with smelters.

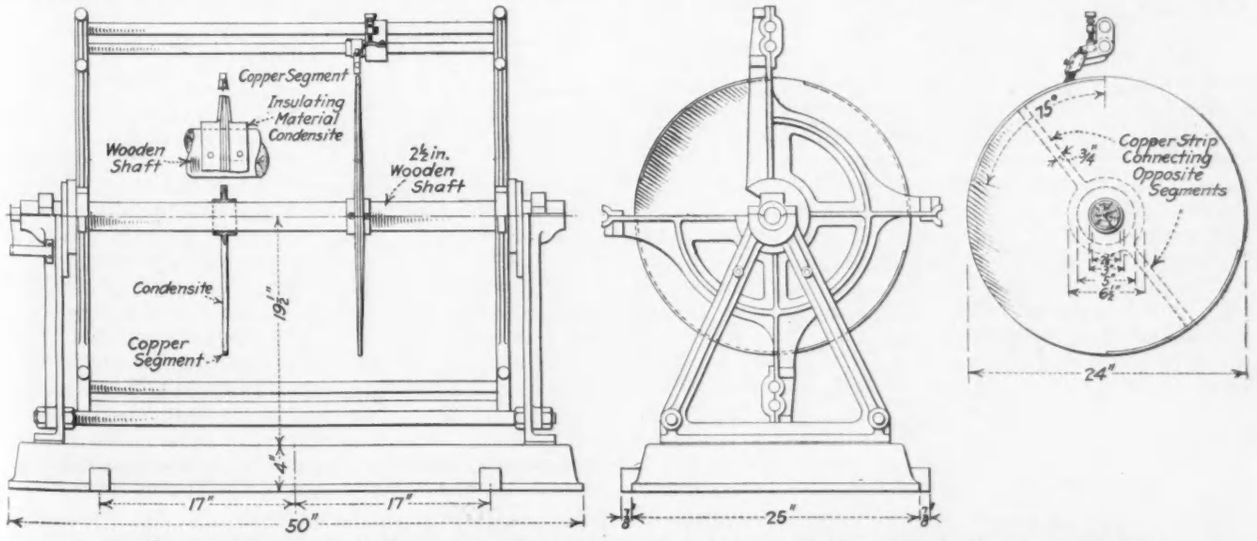


FIG. 7—POSITIVE CONTACT SWITCH TO ELIMINATE SURGES THAT OCCUR WITH SPARK GAP TYPE OF SWITCH

A System of Serially Numbering Customer's Meters

A Combination of Numbers and Letters that Indicates Meter Rating, Type and Make and Simplifies Indexing and Filing of Meter Records

BY W. H. FELLOWS

Superintendent Meter Department, Potomac Electric Company, Washington, D. C.

ABOUT five years ago the meter department of the Potomac Electric Company, Washington, D. C., decided to adopt a serial system of numbering customer's meters for the reason that the manufacturers' numbers on the meter name plates were not sufficiently legible to meter readers and resulted in considerable annoyance. This was especially true where a customer had more than one meter. In the company's former practice of using manufacturers' numbers the type and size of the meter were also linked with them. This required considerable labor and in selecting the new system of numbering it was deemed desirable to incorporate all this information in the meter number itself. In this way the filing and indexing of the company's numerical card records containing one card for each meter could be greatly simplified.

The system of numbering devised is briefly explained by the keys in the accompanying tables. A meter number is formed as follows: First the proper key number is selected for rating and used as the first or first and second digits of the meter number, the following two

TABLE I—KEY NUMBERS AND LETTES INDICATING METER RATING, TYPE AND MAKE

Key Number	Ampere Rating	Key Letter	Type and Make	Key Number	Ampere Rating	Key Letter	Type and Make
1	3	A	G.E. Copper Disk	15	120	L	Ft. Wayne Tp. K1
2	3.5	B	G.E. Alum. Disk	16	125	M	Ft. Wayne Tp. K2
3	5	C	G.E. Type C	17	150	N	Ft. Wayne Tp. K3
4	7.5	CQ	G.E. Type CQ	18	200	O	25 cycle*
5	10	CS	G.E. Type CS	19	300	P	Ft. Wayne Tp. K4
6	15	D	G.E. Types C6 and C7	20	400	Q	Ft. Wayne Tp. K5
				21	450	R	West. Type CD
7	20	E	Duncan Model E	22	600	S	West. Type CE
8	25	EA	Duncan Model ER	23	800	T	West. Type CF
9	30	F	Sangamo Mercury	24	1000	U	G.E. Type I
10	40	G	Columbia	25	1200	V	G.E. Type I-10
11	50	H	West. Type CW6	26	1500	W	.....
12	75	I	.....	27	2000	X	West. Type OA
13	80	J	.....	28	2500	Y	Polyphase (3)
14	100	K	Ft. Wayne Tp. K	29	3000	Z	Sangamo Induc.

*When placed before entire number.

places give key letter and key number of Table II. Following these three parts, which give respectively the current rating, the make and type, the voltage and wire rating of the meter, are placed the digits giving the serial number of the meter.

The following examples show the manner in which the tables are applied in selecting a meter number.

It is evident that when a system meter number is known, the type and rating of the meter can at once be determined by reference to the tables. In practice, the meter men become so familiar with the tables that in place of speaking of a meter as a 5-amp., 110-volt, two-wire, C6 meter they simply call it a 3D1 meter. It will be noticed that all of the direct-current meters are designated by numbers containing letters previous to "K" in the alphabet. The alternating-current meters are indicated by numbers containing letters from "K" down to the end of the alphabet. The letter "A" indicates the oldest type of General Electric meter, the letter "B" the second oldest and so on. The letter "K" indicates the oldest type of Fort Wayne meter, the letter "L" the second oldest and so on, including the letter "Q." The letter "O" is omitted because of the danger of confusing it with zero. A three-phase meter is indicated by the letter "Y" placed in front of the key letter in the serial number of a meter. The letter "O" is placed in front of a serial number to designate a 25-cycle meter. Meter numbers on 25-cycle instruments

TABLE II—KEY NUMBER USED TO INDICATE CHARACTER OF METER CONNECTION AND VOLTAGE

Key No.	Wire and Voltage	Key No.	Wire and Voltage
0	Two-wire, 55 volts	6	.....
1	Two-wire, 110 volts	7	Two and three-wire, 2200 volts
2	Two-wire, 220 volts		
3	Three-wire, 220 volts	8	Two and three-wire, 6600 volts
4	Two and three-wire, 440 volts	9	Two and three-wire, 13,200 volts
5	Two-wire, 550 volts		

are entered on meters with red ink, while the numbers on 60-cycle and direct-current meters are applied with black ink.

The fact that the letters of the alphabet are used to designate the types of meters permits the use of sections that are alphabetically arranged in the numerical files. For example, take meter No. 12Q31450. Its card is filed, first, with respect to the letter "Q" indicating a Fort Wayne Type-K5 meter; second, with respect to the first digit 3 after the letter, the digit "3" indicating a 220-volt, three-wire instrument; third, with respect to the number 12 before the letter, the number 12 indicating a 75-amp. meter; and lastly, with respect to the specific meter number 1450 following the first digit after the letter.

Three-phase meters are filed in the latter part of "Y" section, while 25-cycle instruments which have the letter "O" placed in front of their meter numbers are filed in a separate compartment. In this way the number of meters of any particular make, type and capacity either in stock or in service can be easily obtained, as separate cabinets are employed for filing the cards of meters in service and in stock.

Since devising this numbering system it has been the practice of the company to number serially all of

System Number	Meter Data
11A3211	General Electric copper-disk, 50-amp., 220-volt, three-wire, 211th meter.
14CQ31	General Electric Type CQ, 100-amp., 220-volt, three-wire first meter.
3P12	Fort Wayne, Type K4, 5-amp., 110-volt, two-wire, 60-cycle, second meter.
11YU31	General Electric polyphase, Type I, 50-amp., 220-volt, three-wire, three-phase, 60-cycle, first meter.
O3Q311	Fort Wayne, Type K5, 5-amp., 220-volt, three-wire, 25-cycle, eleventh meter.
O10YT43	Westinghouse, Type CF, 40-amp., 440-volt, three-wire, three-phase, 25-cycle, third meter.

the old and new meters sent from the shop to be installed. The numbers are placed on the dials of the meters and can be easily read at a distance of 5 ft. or 6 ft. under favorable conditions. Moreover, no interchange of numbers and meters can occur as would be possible if the serial numbers were placed on the meter cases, as in the case of manufacturers' numbers. Most of the serial numbers are printed on the meter dials by means of a rubber stamp similar to a dating stamp, "opaque" waterproofing ink being used on the stamp pad. After a meter is numbered in this way its number is carefully checked before the instrument is sent out. At present about 70 per cent of the meters on the company's circuits are now numbered in this way. This system is the result of a study of several similar schemes.

Installation of a Special Pole-Top Regulator

How an Unexpected Demand Was Met at Small Expense by Use of Modified Station Style Regulator—Comparisons of Solutions to Problem that Led to Adoption of the Equipment for a Middle-West System

OPERATING problems frequently arise which must be solved by utilizing some new apparatus or a different application of existing equipment. If experience along similar lines is not available it is usually necessary to proceed along more or less cut and dried methods to secure an adaptation that will meet the requirements imposed on the scheme being used. From this standpoint the experience of one company in installing and operating regulator equipment on poles will be related and the conditions that lead up to its use outlined. While there is nothing particularly novel about the apparatus used or manner of using it, the installation was made at little expense, with complete satisfaction, and met an embarrassing situation that arose unexpectedly. Similar installations might be used to good advantage for supplying sudden short-duration demands such as arise at yacht and country clubs, when it would be impossible or uneconomical to install copper capable of carrying the peak loads.

Conditions which Called for Outdoor Regulator

In the case referred to, a four-wire, three-phase circuit, 4000 volts delta and 2300 volts star, served a three-phase power load a few thousand feet from the generating station, and single-phase loads were connected between different phase wires and the neutral at about 7000 ft. and 33,000 ft. respectively from the station. The circuit consisted of several thousand feet of No. 0 underground four-conductor cable, the remainder being overhead construction, partly No. 0 gage and partly No. 6, with a conductor spacing of 14 in. Three single-phase induction regulators—one in each phase at the station—maintained the voltage of the various phases according to their load requirements. These regulators were controlled by contact-making voltmeters of the compensated type. A fourth compensator was installed in the neutral conductor, as it is usually called, to care for unbalance caused by unequal loads and the very great difference in phase lengths.

For a long time everything was quite satisfactory, but as the community supplied by the long phase grew its load likewise increased, not only during the lighting period, but, due to the use of small single-phase motors, also during the day. Finally, a condition was reached where the voltage drop at the end of the long phase was greater than the range of the regulator. Consequently it became necessary to reduce this voltage drop during the few hours comprising the peak-load period, or else furnish additional voltage somewhere along the line. The length of the line was 33,000 ft., so that to reinforce the copper would be rather costly, the more so since this copper would be called upon for full duty only during a very short period each day. This conclusion was reached after making a complete survey of the load and a careful estimate of the cost of stringing additional copper for the existing and future needs, taking into consideration the load that might be expected during the immediate and the following winters. As is so often the case, it was found impossible to determine the probable load a year hence.

Something had to be done immediately, because the winter load was fast increasing and because the company made it a special point to keep within the limits of voltage variation allowed by the public service commission. Installation of a distributing transformer to act as a "static booster" had already been made, but the point had been reached where even this was incapable of compensating for the line drop on the load side. In similar cases the advisability of transmitting at 10,000 volts instead of 4000 would have been considered, but in the present instance the use of underground cable prevented this, while other factors such as climatic conditions, the number of transformers other than standard that would be required, and the available time in which to make the change, would also have had to be taken into consideration.

Use of Station Regulator Outdoors

Installing a pole-type regulator offered a way of obtaining quick and satisfactory results. Since an estimate indicated that the on-coming load would be about 45 amp. at 2300 volts, the use of standard pole-type regulators, which are made in 2.2 kva. sizes only (220 volts and 10 amp.) was clearly out of the question. A station-type regulator rated at 11.5 kva., however, would care for the load, with spare capacity for a small increase thereof, so its adoption was decided on.

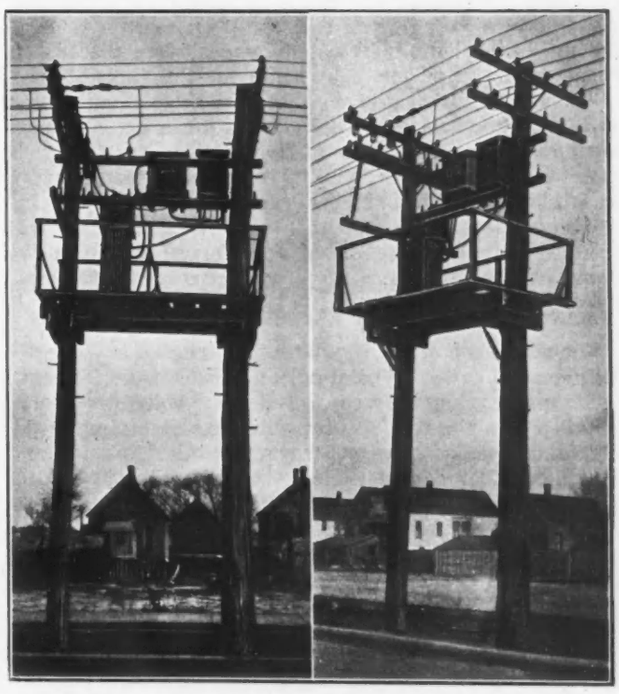


FIG. 1—STATION-TYPE REGULATOR AND ACCESSORIES INSTALLED ON ELEVATED PLATFORM

For reasons which have no bearing on the problem it was necessary to install this regulator about 17,000 ft. from the station or about 16,000 ft. from the center of distribution of the load to be served. Therefore, the conditions to be met corresponded almost exactly with those existing in stations. The only difference between the two was that the apparatus had to be installed outdoors, where personal supervision could not be provided, instead of indoors with an attendant to watch it. In addition to the regulator, which was of

the induction type, the equipment required for the installation included a contact-making voltmeter, series and shunt transformers for the control of the contact-making voltmeter, a shunt transformer for energizing the regulator motor and a reversing relay. Facilities were also provided for permitting rapid disconnection of the regulator in case of trouble. In considering whether to place the equipment on the ground or on poles, it was decided that if the apparatus were placed upon the ground it would need a weather-proof housing requiring space which was not available, since the location was within the city limits and trouble and complications might crop out as the locality was developed.

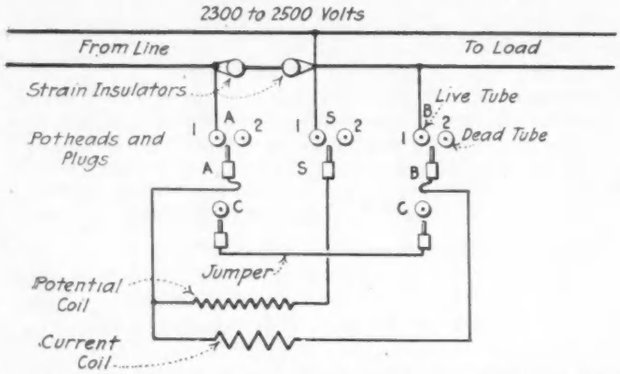


FIG. 2—POTHEAD RECEPTACLES AND PLUG CONNECTORS FOR INSERTING REGULATOR IN CIRCUIT

On the other hand, if the equipment were placed on poles no special permit or expense for the right-of-way would be required, the cost of building a moisture-proof house would be obviated to a large extent since the apparatus could be built for outdoor service, and there would be less possibility of persons maliciously or mischievously injuring the apparatus or coming in accidental contact therewith. The installation above ground was, therefore, made after erecting one additional pole, as shown in the accompanying illustration.

METHOD OF INSTALLING REGULATOR AND AUXILIARIES

The entire top of the regulator was incased in a tight-fitting metal cover. The shunt and series transformers for the control of the contact-making voltmeter were installed in a wooden housing, while the reversing relay and contact-making voltmeter were installed in another. It was considered preferable to separate the apparatus requiring high voltage from that utilizing low voltage because of the possibility of the repairman making mistakes. Both housings were lined with asbestos cloth and padlocked. The housing containing the high-voltage equipment was marked "Danger—2500 Volts."

The regulator was connected with the line through disconnecting potheads, as indicated in an accompanying drawing, to permit taking the regulator out of service with a minimum loss of time. All control wiring was protected by galvanized conduit, which in turn was grounded permanently. The "ground" on one side of the shunt transformer was connected to the circuit neutral and was, of course, kept clear of the earth. In addition, lightning arresters were installed on each side of the installation. Since a transformer was already in place for supplying a small lighting load, it was unnecessary to install another for energizing the motor that operates the regulator. Fortunately, the transformer mentioned was on the "line" side of the pole-type regulator, otherwise the motor might have been required to operate at a voltage considerably above normal. To permit inspection and repair of the apparatus, a wooden platform about 3 ft. wide, was built on one side of the poles, with a railing about 3 ft. high around it, to prevent the lineman from falling off. The general arrangement is shown in accompanying illustrations.

While the installation described was rather more costly and troublesome to make than one consisting of ordinary pole-type regulators which can be installed on one pole instead of two, this equipment has now been in service for a sufficient length of time to demonstrate its ability to perform the work required of it. In weather that has been severe, with heavy snowfalls and sleet formations, no interruption to service can be attributed to the installation, either from the elements or from intentional interference. Very little attention is given the regulator. Once each month a man cleans the contacts of the contact-making voltmeter, at the same time oiling the moving parts of the regulator. In justice to the equipment it might be said that such frequent inspection is hardly necessary.

At present the regulator operates at about full-rated current during the peak-load period, and is then in about the full-boost position. On a line of greater current-carrying capacity, or of shorter length, a regulator of this rating could be used for considerably heavier current because of the better heat dissipation due to faster air circulation obtained on the poles than on the ground or in a station. This might not apply in very warm climates but is worth keeping in mind, especially where the load factors are favorable. On a large system, where an extensive distributing system covers outlying territory and serves every possible class of customer, or for the smaller company, for that matter, it might be well worth while keeping one or two pole-type regulators available for temporary installation at different places as operating conditions dictate.

Line Crew Contest to Be Staged for the N. E. L. A. Delegates

To give delegates to the National Electric Light Association convention at Chicago an opportunity to witness actual work of efficient service crews, and to see in detail the construction of special service-crew wagons and other equipment, the Commonwealth Edison Company will stage during convention week a "service contest" similar to the one conducted at its field-day celebration last June. The contest will be between three crews—the best from each of the company's three service districts in the city—and will consist of doing all work incident to installing a customer's service, including hanging of a transformer, connecting it to primaries and secondaries, running the service drop, connecting it and lighting a lamp on a wall representing a customer's premises. The three crews will work simultaneously.

First, second and third prizes will be awarded the competing crews on the basis of not only the lapse of time required to complete the work, but also the strictness with which all members of the crew observe the company's construction and safety rules. If the installation can be completed in less than fifteen minutes the crew accomplishing the feat will be awarded a further bonus of 10 cents per second for every second under the fifteen-minute mark. While the best mark set in last year's contest was fifteen minutes and forty-eight seconds, it is expected that this year's contest will be speedier than any previous one.

The poles and walls on which the work will be done will be set in Grant Park just east of the Van Buren Street viaduct over the Illinois Central Railroad. This location is within two blocks of the convention hotels, and it is planned to hold the contest just before or just after one of the Tuesday convention sessions, so that all delegates can attend.

Operating Data for Two Kansas Plants

Analysis of Total Electric-Service Expenses to Show Relation of Operating Expenses Thereto and to Indicate Importance of Other Expenses

PRESENTED herewith are some operating data on electric service plants at Topeka and McPherson, Kan. The latter has a commission form of government which makes complete records of expenses. The figures have been arranged to agree as closely as possible with standard classifications of accounts as prescribed by public service commissions. The relations between McPherson operating expenses for 1914 and 1915 differ principally because the water department shared the expenses in 1914, whereas in 1915 the electric department operated independently, charging the water department for all energy used. It may be pointed out that all city water is pumped by electricity and that almost as much energy is supplied for electric cooking as for industrial motor drive. The accompanying curves show typical loads in April and December. The increased day load is attributed chiefly to range and motor loads that have been added. An idea of the size of the distribution system may be obtained from the fact that the pole lines are valued at $14,850. The series-tungsten street lighting line is valued at $5,599. The total value of the electric department is given as $59,475.

Shown herewith are the total cost of production and unit costs, or costs per kilowatt-hour, for 1915. The figures do not include fixed charges such as interest, depreciation, etc. The sales of cinders, $81, and exhaust steam heating, $656.50, have been deducted from the total cost of fuel, leaving $4,164.16, as the net cost of fuel for the year. This is done for the reason that it is necessary to turn live steam into the heating mains during the coldest weather. On the percentage basis it is seen that the cost of fuel is 56 per cent of the total operating expenses,

GENERAL STATISTICS ON McPHERSON PLANT

Prime movers (type)	engines
Total generator rating (kilowatts)	274
Annual energy output (kilowatt-hours):	
Total	442,164
Per capita	109
Per consumer	591
Coal cost, ton	$2.55
Consumption (pounds per kilowatt-hour)[1]	8.7
Population	3,546
Consumers (light)	748
Annual income per capita[2]	$5.38
Per consumer	$29.15
Per kilowatt-hour[2]	$0.04
Load factor[2] (annual)	20.293

[1]Computed from total cost of coal, unit cost and energy output.

[2]Average for all plants in Kansas shows output per capita per year is 79, income per kilowatt-hour is 2.19 cents, and annual load factor is 22.

ANALYSIS OF PLANT EXPENSES FOR McPHERSON

Office Expenses	1914 per Cent	1915 per Cent
Salaries of superintendent and office help	78.3	69.8
Postage, telegraph and telephone	2.1	4.4
Office expenses	1.1	1.1
Books and office supplies	3.2	7.2
Insurance	11.1	12.1
Advertising	2.6	1.1
Furniture and fixtures	0.9	2.7
New building equipment	0.2	0.8
Building repairs	0.5	0.8
Total	100.0	100.0
Percentage of grand total	10	7

OPERATING EXPENSES DUE TO STATION OPERATION (McPHERSON)

	1914	1915
Station labor	30.5	23.3
Oil	3.6	1.4
Waste and packing	1.6	0.8
Tools and repairs on tools	1.7	2.4
Plant expenses	0.2	0.6
†Fuel	54.3	51.2
Boiler compound	1.1	0.2
Steam equipment	1.6	11.9
Steam equipment repairs	4.8	6.2
Electrical equipment	0.4	.....
Electric equipment repairs	0.2	0.1
Amount paid to water department for water	.....	1.9
Total	100.0	100.0
Percentage of grand total	38	36

†In 1914 the fuel bill was divided two-thirds to the electric department and one-third to the water department, while in 1915 all the fuel and boiler compound was charged to the electric department, and the water department being charged with energy for pumping. All city water is pumped by motors.

OPERATING EXPENSES DUE TO DISTRIBUTION AND UTILIZATION

	1914	1915
Pole line construction—material	28.3	39.6
Pole line construction—labor	3.8	7.6
Repairs on pole lines	8.9	2.5
Series-tungsten street lighting	3.0	1.9
Series-tungsten lamps	7.4	6.0
Repairs on series-tungsten lines (labor and material)	6.3	3.6
New service wires (labor and material)	6.9	6.5
Repairs on service wires (labor and material)	2.0	1.1
Electric meters	28.1	23.9
Installing electric meters	1.0	1.4
Change, repair and read electric meters	4.0	4.4
Inspections	0.2	1.1
Disconnections	0.1	0.4
Total	100.0	100.0
Percentage of grand total	14	19

MISCELLANEOUS EXPENSES (McPHERSON)

	1914	1915
Refund on light	0.1	.....
Compromise on old generator	1.1	.....
Expense in locating superintendent	0.2	.....
Damage to 'phone by arc line	0.1	.....
Bonds purchased	.....	70.0
Interest on bonds	18.1	12.8
Outstanding warrants paid	71.9	5.3
Merchandise	7.8	10.7
Deposits	0.7	1.2
Total	100.0	100.0
Percentage of grand total	39	38
Grand total**	18,256.08	26,594.75
Income from sale of energy	$15,320.47	$21,808.39
Total receipts	$18,256.08	$28,117.85

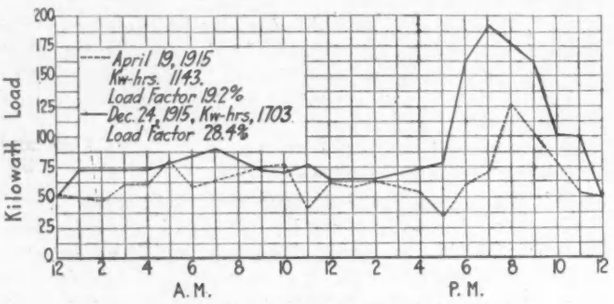
**It may be pointed out that depreciation, obsolescence, interest on investment and loss of taxes were overlooked by the electric department in making this record.

CLASSIFICATION OF REVENUE FOR 1915 (McPHERSON)

	Kilowatt-Hour Output	Per Cent of Total Output	Total Income	Per Cent of Total Income
Residence and commercial lighting	235,034	53.5	$16,307.39	75.0
Pumping water	100,620	22.6	1,760.85	8.0
Street lighting	68,233	15.4	2,116.93	9.6
Power	21,976	4.9	966.58	4.4
Cooking	16,301	3.6	656.64	3.0
	442,164	100	$21,808.39	100

or 14 per cent of the total income. This includes the cost of fuel for firing up cold boilers. Owing to the necessity of using boiler compound considerable heat is lost in blowing off boilers more than would be necessary under more favorable conditions. Furthermore the plant operates at relatively low efficiency due to underloads.

On Jan. 1, 1915, a rate of 4 cents per kilowatt-hour



TYPICAL LOAD CURVES FOR MC PHERSON PLANT

was established for cooking, and after a year's trial the results have been so satisfactory that the rate was reduced, on Jan. 1, 1916, as an inducement to other consumers to take advantage of the modern method of cooking. The present rate is 4 cents for the first 50 kw.-hr., and 3 cents for any amount above. In addition to the revenue resulting from the sale of energy the electric department received revenue for rental of meters, schoolhouse heating, sale of merchandise and sale of series-tungsten lamps. Some revenue was also realized by sell-

ANALYSIS OF STATION OPERATING EXPENSES (McPHERSON)**

Item	Amount	Per Cent of Total	Cost per Kilowatt-Hour
Fuel	$4,164.16	56	$0.009417
Labor	2,237.05	30	0.005059
Oil, waste, packing	213.55	3	0.000483
Compound and water	197.90	2	0.000447
Repairs, plant expenses	674.20	9	0.001524
Total	$7,486.86	100	$0.016930

**This data is computed from that tabulated on page 1103, after crediting the fuel expense with an amount representing receipts from sale of cinders and exhaust steam.

ing old poles, wire tubes, brackets, insulators, junk wire, old brick, cinders, an old boiler, oil barrels, old meters, etc. These secondary sources raised the 1914 and 1915 receipts to $18,256 and $28,118 respectively.

The electric department pays interest on $75,000 bonds, which amounted to $3,429 for 1915. The street lighting system consists of 318 lamps, all of the gas-filled type and ranging in size from 40 cp. to 100 cp. The White Way consists of forty two-lamp standards equipped with 100-watt units. There are thirty-one power consumers with forty-two motors and a connected load of 170 hp., and sixteen cooking consumers with a connected load of 70 kw.

PERFORMANCE OF TOPEKA PLANT

The Topeka plant furnishes energy only for street, ornamental and sign lighting so that the conditions are not comparable with those in McPherson where residence lighting, cooking and industrial motor loads are also carried. An idea of the relative amounts of capital invested in different parts of the plant may be obtained from an accompanying analysis. From this table it may be observed that the investment for generating equipment represents only about one-third of the total plant investment. It may be pointed out further, that the in-

STATION PERFORMANCE DATA (TOPEKA)

	1914	1915
Pound water evaporated pound coal	7	6.9
Pound coal, kilowatt-hours	6.2	5.93
Percentage of coal for banking fires	.....	5.6

vestment in rectifiers is a large portion (more than 35 per cent) of the station investment. The wires, insulators and cables represent almost half the investment in outside equipment.

Referring to the plant expenses, generation expenses make up about 38 per cent of the total, but the combined expense of insurance, interest, depreciation and loss of taxes ranks as close second, being about 34 per cent of the total. Of the generating expenses, costs of fuel and labor represent about 54 per cent and 33 per cent respectively and repairs to steam equipment over 6 per cent.

ANALYSIS OF PLANT INVESTMENT (TOPEKA)

	Per Cent	Per Cent of Total Plant Investment
Generating plant:		
Boilers, stack, etc.	19.1	6.26
Engine	18.3	6.02
Generator, switchboard, etc.	10.9	3.57
Rectifiers	35.3	11.59
Building and land	16.4	5.40
	100	32.84
Arc lamp equipment:		
Pole line	29.7	8.76
Wires, insulators, etc.	41.0	12.09
Arc lamps	26.3	7.73
Street fixtures	3.0	0.87
	100.	29.45
White way equipment:		
Standards	35.6	13.44
Conduits	15.5	5.80
Cables	47.3	17.89
Switches	1.6	0.58
	100.	37.71

RATIO OF INDIVIDUAL EXPENSES TO TOTAL IN PER CENT (TOPEKA)

	1913	1914	1915
Administration } Insurance }	6.9	5.9	4.6 / 1.3
Loss of taxes (1.904 per cent)	6.5	6.0	5.8
Interest (4 per cent)	14.9	13.8	12.3
Depreciation (4.62 per cent)	18.7	17.3	14.2
Generation } Transmission }	53.0	57.0	23.8
	100.0	100.0	100.0
Output (kilowatt-hours)	579,570	709,330	786,286
Generating cost per kilowatt-hour at switchboard, in cents	2.099	1.651	1.64

OPERATING EXPENSES DUE TO GENERATION (TOPEKA 1915)

	Cents per Kilowatt-Hour	Per Cent of Operating Expense
Coal cost and unloading expense	0.89	54.3
Oil, rags and waste	0.02	1.2
Station and yard maintenance	0.01	0.6
Boiler-room labor	0.29	17.7
Steam equipment repairs (boilers, auxiliaries, pipe lines, auxiliaries, engines and auxiliaries)	0.10	6.1
Engine room labor	0.25	15.2
Electric equipment repairs (generators, exciters and switchboard)	*	*
Sundry items	0.08	4.9
Generating cost at switchboard	1.64	100.0

*Negligible.

STATION AND OPERATING PRACTICE

A Department Devoted to Problems of Installation, Operation and Maintenance of Equipment for Economical Generation and Distribution of Electrical Energy

Installation Features at Alexandria (Va.) Steam Station

Method of Supporting 1250-Kw. Turbine on Steel Frame—Combined Motor and Turbine Drive for Circulating Pump—Station Operation Shows Coal Consumption Reduced to 2.35 Lb. per Kw.-Hr.

BY FRANCIS R. WELLER
Consulting Engineer, Washington, D. C.

There are two interesting installation features at the recently enlarged generating station of the Alexandria (Va.) County Lighting Company. These features are: (1) The method of supporting a 1250-kw. turbine upon a structual steel frame, and (2) a double drive for the centrifugal circulating pump.

During the latter part of 1915 a 1250-kw., three-phase 60-cycle, 3600-r.p.m. General Electric steam turbine with surface condenser and auxiliaries were added to the Alexandria (Va.) station. The turbine is mounted on a steel frame supported on six Bethlehem H12, 64.5-lb. columns, as shown in Fig. 1. The height of the turbine floor above the basement is 11 ft. In order to overcome any possible lateral vibration, stiffening angles were attached to each column and the transverse floor beams. Around the turbine there is a walkway of checkered floor plates supported on channels attached to the main girders supporting the turbine. When the turbine is in operation there is almost an entire absence of vibration. This construction enables the condenser to be placed directly under the turbine, eliminates all dark corners, all parts of the installation are accessible, and the arrangement of the piping to the turbine and condenser is greatly simplified. Structural steel turbine supports can be quickly erected, and they are somewhat cheaper in first cost than the standard concrete or reinforced concrete foundations. The condensing equipment was furnished by the Wheeler Condenser & Engineering Company, and consists of one Admiralty type surface condenser, containing 3750 sq. ft. of cooling surface made up of 0.75-in. seamless drawn-brass tubes 12 ft. 6 in. long packed at both ends. The condenser is arranged for two passes for the circulating water. An 8 in. by 20 in. by 12 in. Wheeler Edwards single wet vacuum pump operating at 125 r.p.m. is connected to the condenser, and on the same bedplate with this wet vacuum pump is mounted a 5.25 in. by 4 in. tail pump actuated through a steel connecting-rod working from a steel crankpin on the main crankshaft of the wet vacuum pump. This pump discharges the condensate into an open feed-water heater. Saturated steam at 150-lb. pressure is used in this plant, and the condensing

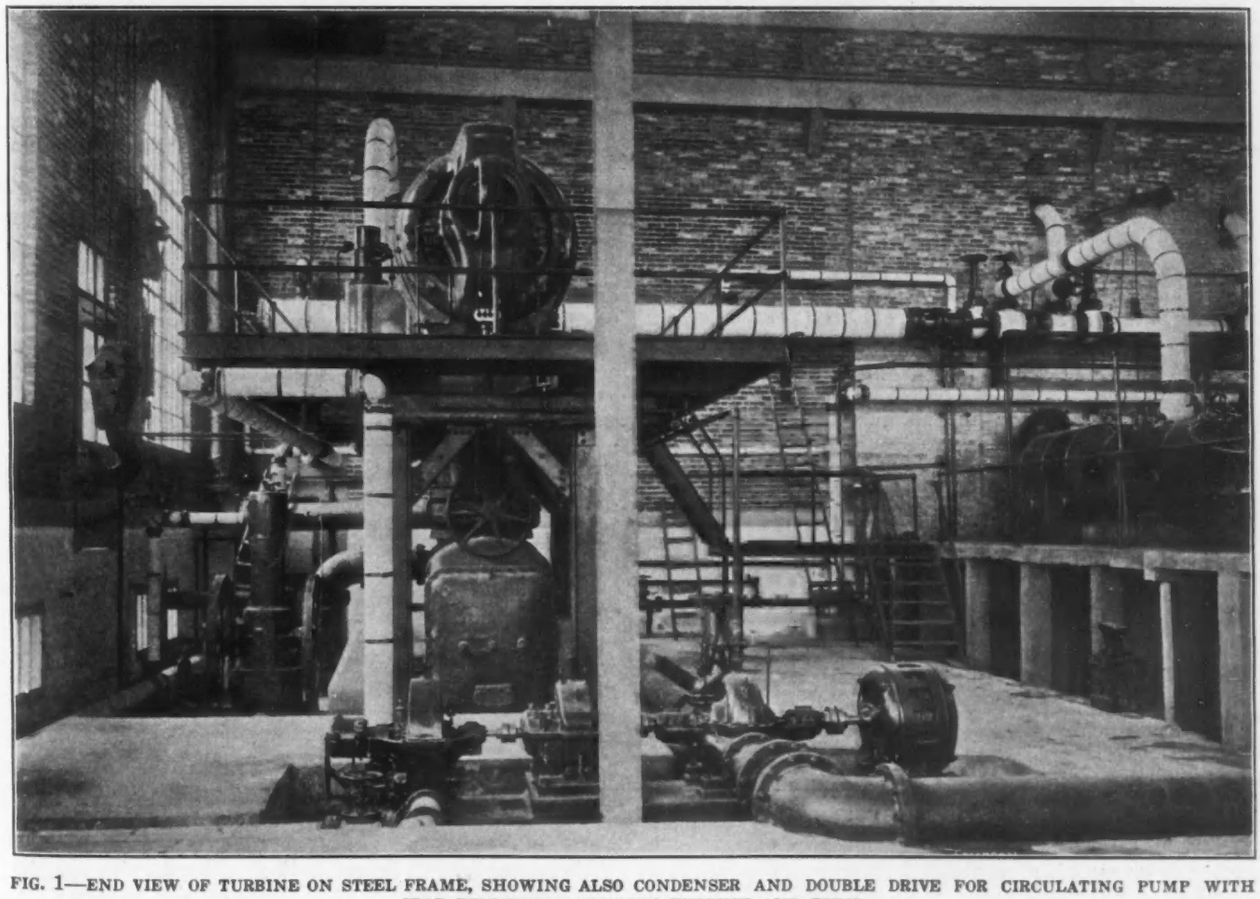


FIG. 1—END VIEW OF TURBINE ON STEEL FRAME, SHOWING ALSO CONDENSER AND DOUBLE DRIVE FOR CIRCULATING PUMP WITH GEAR REDUCTION BETWEEN TURBINE AND PUMP

equipment is guaranteed to handle 25,000 lb. of steam per hour and maintain a vacuum of 28-in. referred to a 30-in. barometer when supplied with 3000 gal, of water per minute at a temperature not exceeding 75 deg. Fahr. This guarantee has been more than fulfilled since the equipment has been in operation.

Combined Motor and Turbine Drive for Circulating Pump

The circulating pump is a 10-in., horizontal, split-brass fitted centrifugal circulating pump with bronze impeller and brass mounting. It has a rating of 3000 gal. per minute when operating at 720 r.p.m. The

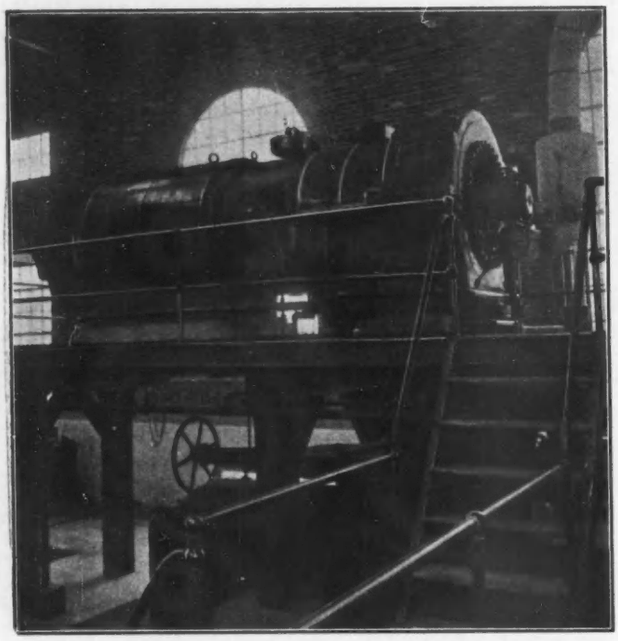


FIG. 2—A 1250-KW. STEAM TURBINE MOUNTED ON STRUCTURAL STEEL FRAME 11 FT. ABOVE BASEMENT FLOOR

theoretical efficiency of this circulating pump is 80 per cent.

On the same bedplate with the circulating pump and direct connected to it is a 25-hp. three-phase, 60-cycle, 2300-volt, Allis Chalmers induction motor and a 21 b.h.p. Terry steam turbine operating at 3100 r.p.m. A Falk reduction gear box is mounted between the pump and this turbine. Flexible couplings are used for connecting up the turbine to the reduction gear box and also to the circulating pump. This installation is shown in the foreground of Fig. 1.

At the present time, the design of turbines has been so improved that very low water rates are now obtained. This economy in steam consumption, however, is largely sacrificed at partial loads by the comparatively large amount of power required to drive the condenser auxiliaries, especially in the case of small turbine units. Since the power required to operate auxiliary condenser pumps is practically constant irrespective of the load on the turbine, it is found that in the case of turbine-driven circulating pumps the amount of steam required for operating these auxiliaries at partial loads represents a considerable percentage of the total steam consumption of the unit. At the full load of the turbine, however, all of the exhaust steam from the auxiliary turbine can be properly utilized in raising the temperature of the feed water entering the boiler. Except when turbines are operated at practically 100 per cent load factor, it is evident that during periods of partial load, motor drive would be more efficient whenever there is a surplus of exhaust steam required for heating feed water. Moreover, at light loads, the motor operating the circulating pump will increase the load on the main unit, and thereby slightly increase the economy. At full load, however, it is desirable that no part of the capacity of the main unit should be required for operating the auxiliaries and at such a load it is desirable to operate the auxiliary turbine in order to yield sufficient exhaust steam for heating purposes.

By mounting both a motor and a steam turbine on the pump shaft, as in the Alexandria station, it is possible to operate either prime mover, or both, in order to give most efficient results.

Coal Consumption Reduced to 2.35 Lb. per Kilowatt-Hour

This installation has now been in operation for five months and has given excellent results. With a station load factor of 50 per cent, the coal consumption (using Logan County, W. Va., coal, running about 14,100 B.t.u. and 10 per cent ash) has been reduced to 2.35 lb. per kilowatt-hour for one day's run.

The following comparative statement of the output by months, together with coal consumption per kilowatt-hour, will show clearly the marked increase in plant efficiency due to the operation of the new installation compared with previous operating conditions. It is to be noted that the average coal consumption per kilowatt-hour for the months shown includes also the light Sunday loads.

While the lowest coal consumption for a single day was 2.35 lb. per kilowatt-hour, a coal consumption under 2.5 lb. has been obtained for a number of other days during this period.

	Kw.-Hr. Output	Coal per Kw.-hr., Lb.
December, 1914	242,502	3.58
January, 1915	252,073	3.59
February, 1915	260,868	3.68
March, 1915	272,589	3.58
December, 1915	298,272	2.76
January, 1916	307,176	2.74
February, 1916	278,805	2.94
March, 1916	284,545	3.01

The Alexandria County Lighting Company is owned and operated by the Municipal Service Company of Philadelphia, Pa., H. T. Hartman, president. Similar turbine installations have been recently placed in two other power plants controlled by this company, one at Staunton, Va., and the other at Coatesville, Pa. In each of these plants a motor-driven centrifugal booster pump has been installed to operate in series with the circulating pump when the cooling tower is used. At Staunton, the company has installed a vertical type of condenser in order to facilitate cleaning of the tubes. The water used for condensing purposes contains at times large amounts of sewage, and for this reason it was deemed advisable to use a vertical condenser.

The work of enlarging the three plants mentioned was done under the direction of the writer.

A Limit of Boiler-Water Density to Prevent Tube Failure

Boiler tubes may fail due to bagging, blistering, warping, or swelling if the water in them is allowed to become too impure or dense. If this condition occurs the furnace heat may drive the water completely away from the lower tube surfaces by the sudden formation of steam and violent foaming. According to the Au Sable *News*, which is published periodically by the Consumers Power Company, Jackson, Mich., the density of water in boilers should not be allowed to exceed 1.003 if they are operated above rating. The density may be obtained by testing water taken from the blow-off.

Causes of Lamp-Hours Out on Detroit Municipal Lighting System

According to the twentieth annual report of the Public Lighting Commission of the city of Detroit, just published, 8193 arc lamps are operated by the city lighting plant. During the twelve months covered by the report the average number of lamps operated per month was 7487, with outages amounting to a total of 30,638 lamp-hours for the year. The total lamp-hours scheduled was 29,207,855, which shows the lamp-hours out to be about one-tenth of 1 per cent. The causes of the outages as reported are as follows:

	Lamps Out	Outage Lamp-Hrs.
Line and cable trouble	7,938	14,472
Lamp trouble	2,733	14,000
Trimmer's neglect	15	67
Station trouble	4,759	2,099
Totals	15,445	30,638

The net cost of operation and maintenance per arc lamp for the year ending June 30, 1915, was $24.28, against $25.21 for the previous twelve months. This is reported as 1.28 cents per kilowatt-hour. Of the 8193 arc lamps operated on the system, 2147 are series-inclosed, alternating-current lamps, 5561 are 4-amp. and 485 are 6.6-amp. General Electric luminous arc lamps. Eleven men are required to trim these units. From the main generating station and each of four of the substations, a patrolman with horse and buggy inspects lamps in an assigned territory immediately after the arc circuits have been started and also attends to any outside trouble that may develop.

How Three Generators Are Operated by Two Belts from One Flywheel in a Kansas Station

In the generating station of the Leavenworth (Kan.) Light, Heat & Power Company a 500-hp. Filer & Stowel simple non-condensing engine drives three generators from two belts on its flywheel. The arrangement of the generators and the belt connections are shown in the accompanying illustrations. The top belt drives two direct-current 110-220-volt generators, each rated at 75 kw. and arranged so that the pulley is between them. The other belt is connected to the pulley of a 300-kw. three-phase, 60-cycle, 2300-volt alternator, which is arranged for parallel operation with either a 500-kw., belt-driven generator or a 500-kw. turbo-generator.

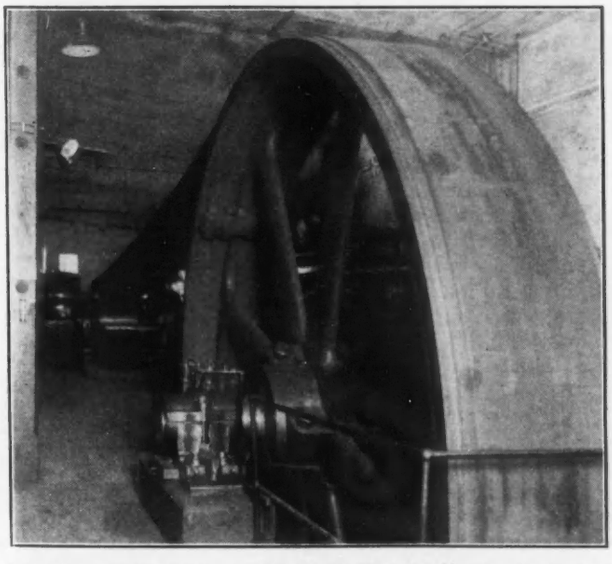


FIG. 1 — TWO BELTS CONNECTING ENGINE FLYWHEEL AND GENERATORS

The arrangement of the generators driven by the double-belt arrangement is such that the distance between the engine shaft and the alternating-current generator is 42.5 ft. The distance between the engine shaft and the pulley of the two direct-current generators is 49 ft. 8 in. The engine flywheel is 18 ft. in diameter and runs at 96 r.p.m., making the belt speed 5430 ft. per minute. The width of the belt driving the 300-kw. alternator is 34 in., and the width of the top belt driving the two 75-kw., direct-current machines is 30 in.

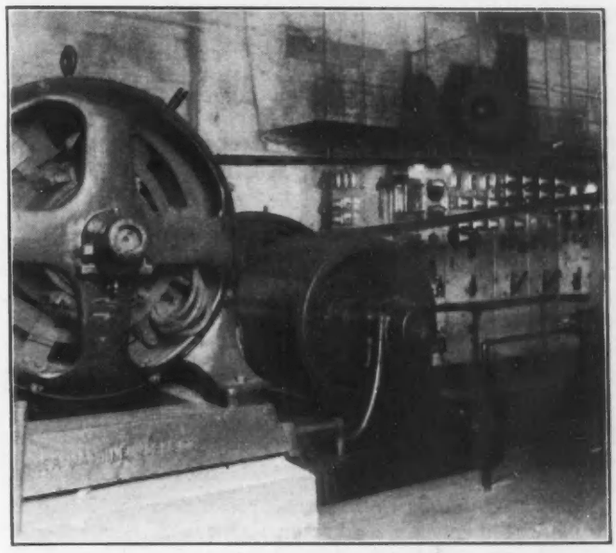


FIG. 2—ARRANGEMENT OF GENERATORS OPERATED BY TWO BELTS ON ENGINE FLYWHEEL

According to W. Schwerin, superintendent of the Leavenworth Light, Heat & Power Company, this arrangement of drive has proved satisfactory in the limited space available for the equipment.

Suggested Reasons for Insulator Deterioration and Its Prevention

Numerous hypotheses have been advanced for the deterioration of high-voltage insulators in course of time, and tests and experiments have been carried out in an attempt to determine the causes. Inferior grade of porcelain or faulty workmanship do not seem to supply the solution, although their bearing on the problem must be kept in mind at all times. Mechanical vibration and strains producing gradual but final failure with or without the assistance of dielectric stresses seems to have been the cause of failure in some cases. In others there is good reason to suspect that sudden temperature changes have caused internal stresses in the insulator on account of unequal expansion and contraction of the body of the porcelain or where porcelain and metal are adjacent, each having different coefficients of expansion. Yet another possible reason appears to be that of ionization of the air in air pockets in the insulator followed by electrolytic action and abnormal stresses. Galvanic action between different metals offers still another plausible explanation under certain circumstances.

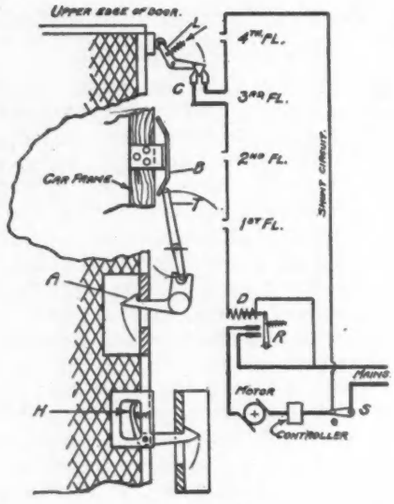
The trouble is so universal that all companies operating high-voltage lines and manufacturers of suspension-type insulators are endeavoring to find an explanation, or at least a preventive. An interesting experiment is being tried out on a large transmission system in Japan, on the hypothesis that the trouble there encountered is due to internal stresses in the insulator.

Between the two parts of each insulator is placed a thin layer of cement. This layer of cement is not laid on in one piece, but consists of three separate sections spaced from each other. The object of this construction is to enable the sections of the insulator to expand and contract, the cement also being free to move longitudinally, but subject to lesser transverse stresses than otherwise would be the case. A number of these insulators have now been in service a considerable length of time with no sign of deterioration.

Another ingenious experiment is being tried out on a Swedish transmission line operating at 70,000 volts. The insulators on this line are of the suspension type, six units composing a string. Before cementing the cap of the insulator and pin into the porcelain, the surface of the insulator is coated with a layer of graphite and waterglass. These conducting layers of graphite and waterglass are then connected to the bolt and cap respectively by means of asbestos washers covered with tinfoil. The object of this construction is to short-circuit the cement binder, and in this way offer a path for the charging current irrespective of the cement. By doing this it is expected that the likelihood of electrolytic action caused by ionization of air pockets will be overcome, while mechanical strains and stresses due to expansion and contraction will be eliminated to a very large extent, if not entirely.

Electrically Interlocking of Elevator Doors and Motor to Prevent Accidents

Illustrated herewith is a control scheme which has been adopted by the Rochester Railway & Light Company for an elevator in one of its stations to prevent the car being started while the door is open and to prevent the door being opened except at landings. According to L. I. Hall in the company's *Gas & Electric News*, when the car is directly opposite a landing—within the limits of a few inches—the bent trip *B* holds trip lever *T* in such a position that it frees the automatic door latch, allowing the door to be opened in the



CONNECTIONS FOR SAFETY ELEVATOR MECHANISM IN RUNNING POSITION

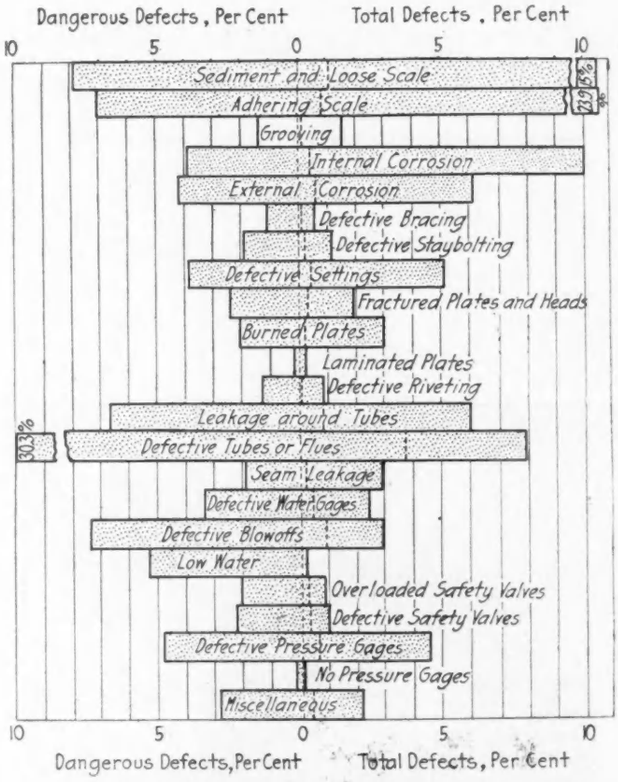
usual manner. The moment the door is even slightly opened a spring-operated lever, *L*, tends to force it farther open, at the same time opening the circuit of a relay which de-energizes the elevator motor supply line. In case a door should be opened just as a car is passing a landing the same operation will take place and the car is brought to a stop.

How Transmission Lines Were Protected During Blasting

When stumps are being blasted in the vicinity of transmission lines it may be advisable to induce the blasters to follow the methods employed along the Seattle toll lead of the Pacific Telephone & Telegraph Company to prevent damage to the conductors and interruption to service. Along the telephone line mentioned the explosive was placed about 4 ft. to 5 ft. beneath the center of each stump. The top and sides of the stump were then covered with brush and saplings which acted as a blanket for the explosion, controlling both the horizontal and vertical distribution of the débris.

Causes of Boiler Defects According to Frequency of Occurrence

The chart shown herewith presents graphically the relative frequency of boiler defects reported by inspectors of the Hartford Steam Boiler Inspection Insurance Company last year. The bars extending to the right indicate the relative numbers of each defect observed, while the bars extending to the left indicate the relative numbers of dangerous defects. The sections extending to the dashed lines represent the ratios of dangerous defects to total defects observed. An analysis of this chart shows that while cases of sediment and scale were prominent the greatest number of dangerous defects were in tubes or flues. This is apparent because a defect in a tube or flue makes it dangerous, whereas de-



ANALYSIS OF BOILER DEFECTS ACCORDING TO CAUSES

fects in other apparatus may merely hinder performance of usual duties and involve no immediate danger. It may be pointed out, however, that the number of dangerous defects due to sediment and scale, blow offs, leakage around tubes and low water is large. Other defects, while relatively small, constituted, in number, almost 40 per cent of the total dangerous defects.

MARKETING ELECTRICITY

A Department on Selling Service and Widening the Use of Electrical Energy

Tips for New Business Which Non-Commercial Employees Can Send In

The Pacific Light & Power Corporation, operating in the vicinity of Los Angeles, Cal., is encouraging its employees in all departments to secure new business for the company. Tips for new installations, apparatus and electric devices are solicited, and noticeable increases are being derived through this added co-operation. To inspire employees to the utmost in this work, the sales department has recently issued the following notice:

Have you ever stopped to think that every employee of this company is or can be a salesman? If this fact were generally realized we would soon have an organization of wonderful effectiveness. Let us suppose that you make it a point to speak to at least one person every day, explaining something about our service or recommending the use of electricity in place of gas or some other competing medium. This would mean 250,000 seeds dropped in a year and would be of infinite value to the company in which we are vitally interested.

Or take another view. If each employee would send in only one tip each month—a tip as to a prospective consumer or a chance at some additional load—this would mean nearly 10,000 opportunities in a year and each opportunity would mean more revenue for us.

Here is the information we want.

Does your neighbor need an electric iron or toaster?
Who needs a motor?
Do you know anybody who is going to move?
Does your corner grocer use gas?
Would your barber buy an electric fan?
Do you know anybody who is going to open up a store or shop?

There are dozens of other tips that will suggest themselves to you. Send them in—we need them.

Arrangement of New Central Station Business Office at Indianapolis, Ind.

The Merchants' Heat & Light Company of Indianapolis, Ind., has taken a seventeen-year lease on the Kahn Tailoring Building at Washington and Meridian streets, that city, a corner which practically all street car lines pass. In this 25-ft. by 125-ft., four-story structure the company is planning to install an appliance salesroom and executive offices on the first floor and accounting offices on the floor above. It will be the company's aim to make the building a most modern central station office deserving of the name it will carry —"The Daylight Corner."

More than one-half of the entire first floor will be given over to the appliance salesroom and customers' department, which will be decorated in gray and white. Along one side of the building there will be no boxed-in show windows, but large plate-glass openings will be used on that side to give passers-by an opportunity to look over the entire salesroom.

In equipping the appliance salesroom every effort will be made to prevent it from looking like merely a portable-lamp display. R. A. McGregor, who has that part of the work in charge, is strongly opposed to the idea of exhibiting so many highly-colored and expensive lamps that the more profitable energy-consuming devices are made unattractive by comparison.

The exterior of the building will be lighted by flood lamps and will carry two electric signs. One of the latter will be a 3-ft. skeleton-letter sign, which will extend along the two exposed sides of the building. Instead of lying flat against the wall, this sign will extend out over the sidewalk so that the flood lamps to light the walls can be hidden behind it. The 28-ft. by 40-ft. roof sign will read, "The Home of the Merchants' Heat & Light Company." The company expects to occupy its new home early in the summer.

Broadway's Latest Skyrocket Sign Novelty

The new Rialto motion-picture theater at Times Square, New York City, challenges the attention of passing Broadway throngs with the novel display shown herewith, which is not only visually spectacular, but audible as well. The huge illuminated central wheel rotates rapidly, and from it as a center "rockets" appear to shoot up distances of 50 ft. and curl over the sign at the top, and as each rocket bursts the corresponding letter is lighted. As each streamer starts the hissing sound of an ascending skyrocket is heard, produced by the escape of compressed air. After all the letters have been lighted, the rockets again ascend and light the whole sign in another color. On the corner of the building is a fireworks flower-pot sign, in which continuous streaks of light shoot through the letters of the sign. The signs on this theater contain some 6000 lamps, and the equipment, which was designed and installed by the Norden Electric Sign Company, New York, includes the mechanism for rotating the wheel, the air compressor for producing the rocket sound, and the flasher operating the rocket effect.

THE NEWEST SIGN ON BROADWAY'S FLASHING FIRMAMENT—A DISPLAY THAT IS AUDIBLE AS WELL AS SPECTACULAR

The Fans That Yield Big Profits

The Month of May Presents the Best Time to Push the Sale of Ceiling Fans and the Wiring Installations That Go With Them

The man who lets the weather sell his fans for him wastes opportunity and loses profit money that would be his for the taking. He throws away one of the best markets of the season—the market for the fan that is mounted on the ceiling. This is the fan that can and should be sold right now in May, for every time a ceiling fan is sold a wiring job goes with it, and the wiring job takes time.

It is not many years ago that all the contractor thought of selling for service in stores was the ceiling fan. It was the standard fan for the purpose and the merchant asked for it, for the desk-type fan had not then won its way to universal popularity—it was young and for big spaces looked both small and toy-like. And so the contractor made two separate and distinct efforts to sell electric fans—and pushed the ceiling type first before the heat of summer brought the voluntary call for desk fans upon him. But the demand for desk fans has increased so greatly with their general adoption for all purposes, that the dealer has been gradually forgetting what the larger fan offers him, and his fan campaign is resolving itself into a process of just laying in a stock of assorted desk fans, putting them in his window when the hot days come, sending out the advertising matter provided by the manufacturer, and taking in profits when the heat-stricken public rushes to buy.

There are three good reasons why the contractor should make a strenuous campaign each year to sell the larger fan—first, it sells for a higher price and brings a bigger profit; second, it must be wired and installed, thus creating further opportunity for profit; and third, it offers actual advantage both to the merchant in the greater air it throws and to the central station in the greater current it consumes. For these reasons the ceiling fan and the gyrating fan should not be overlooked—but they will not sell themselves as desk fans do in the sweltering weeks of June; they must be sold just as you sell exhaust fans.

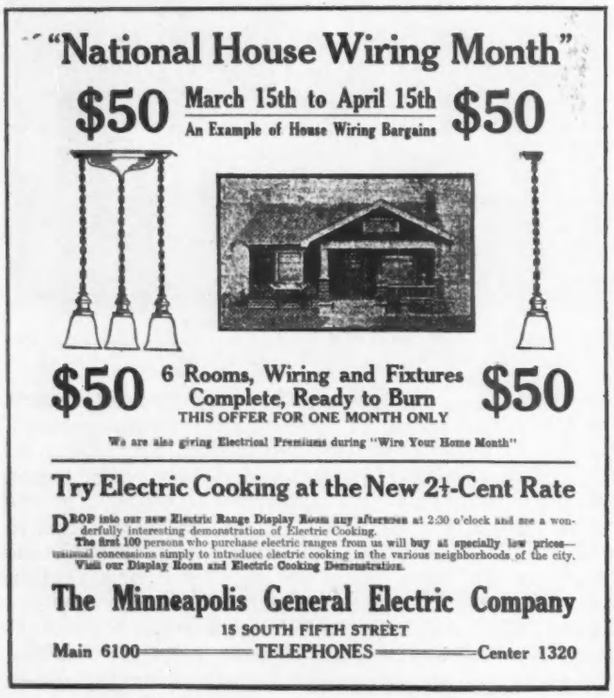
A canvass of the stores, cafes, restaurants and public buildings will disclose innumerable situations where the big fan will provide the better service and good salesmanship will turn the trick if it is done now while there is yet time to do the wiring before the great heat comes.

A Housewiring Campaign where Neutral Territory between Salesmen's Districts was Left Open to Competitive Effort

The Minneapolis General Electric Company reports remarkable success in its campaign to win old houses during "Wire-Your-Home" Month. In all several salesmen were engaged in the work, and preliminary to the campaign they compiled by personal selection a list of 250 homes located along the company's lines, all apparently hopeful prospects for housewiring. Then just prior to the beginning of the "month," three form letters were sent out to this list, covering the general arguments but without mention of the special offer that was to follow.

On March 13 an advertisement was inserted in the local newspapers announcing the special offer of the campaign—to wire and furnish fixtures for a six-room house, complete and ready to burn—for the flat price of $50. This was supported by a return postcard that went direct to the selected list of 250, and brought back twelve contracts immediately, and the salesmen went to work to comb the city. Special districts for this campaign were laid out for each salesman, arranged so that a neutral territory intervened between each two, in which either man was free to hunt in active competition with his fellow. The downtown district was handled independently as a "Wire-Your-Store" campaign, in charge of the regular downtown man.

In all 595 new customers were secured within the month under this plan, though the majority of contracts embraced more extensive equipment, and the average price per contract figured slightly more than $75. These contracts were all turned over to the electrical contractors, the central station salesmen merely producing the inquiries and acting in an advisory capacity to the customers.


"National House Wiring Month"
$50
March 15th to April 15th
An Example of House Wiring Bargains
$50
$50
6 Rooms, Wiring and Fixtures Complete, Ready to Burn
THIS OFFER FOR ONE MONTH ONLY
$50
We are also giving Electrical Premiums during "Wire Your Home Month"
Try Electric Cooking at the New 2½-Cent Rate
DROP into our new Electric Range Display Room any afternoon at 2:30 o'clock and see a wonderfully interesting demonstration of Electric Cooking.
The first 100 persons who purchase electric ranges from us will buy at specially low prices—minimal concessions simply to introduce electric cooking in the various neighborhoods of the city.
Visit our Display Room and Electric Cooking Demonstration.
The Minneapolis General Electric Company
15 SOUTH FIFTH STREET
Main 6100 TELEPHONES Center 1320

208 ALREADY BUILT HOUSES
Throughout the city have wired for Electric Light during the first 15 days of
"WIRE YOUR HOME MONTH"
March 15 to April 15
Only a Few Days More of Our Special Bargain Wiring Offer
$50
6 ROOMS, WIRING AND FIXTURES COMPLETE--READY TO BURN.....
$50
Better call Main 6100 or Center 1320 and arrange for our representative to call.
The Minneapolis General Electric Company
15 SOUTH FIFTH STREET
MAIN 6100 TELEPHONES CENTER 1320

NEWSPAPER ADVERTISEMENTS WHICH SUPPLEMENTED FORM LETTERS TO CUSTOMERS IN MINNEAPOLIS HOUSE-WIRING CAMPAIGN

THE MOTION PICTURE AS AN AID TO THE POWER SALESMAN

It is the *action* of the motor that the customer is to buy—and, except by motion pictures, this action cannot be demonstrated unless the prospect visits many installations, which he will not do.

Increasing Sales by Motion Pictures

How This New Selling Force Will Serve the Electrical Industry —Depicting the Action of the Motor-Driven Appliance

BY T. GRUEN

Vice-President Leggett-Gruen Corporation

Among the great fundamental inventions of recent years none promises to contribute more to business efficiency and progress than the motion picture—regarded so far by most men as a medium for the amusement of the masses.

But the future of the motion picture will be also a commercial one, in which it will become the right-hand of the salesman and a mighty force for progress in the selling of electric-service applications. It stands to reason that anything that increases efficiency or reduces selling cost is of vital usefulness, and the motion picture accomplishes both. It has stood the acid test and its value is to-day fully recognized by shrewd business men, some of whom, realizing its adaptability to the industrial world, have adopted it as a valuable sales ally.

PICTURING THE MACHINE IN MOTION

Many manufacturers have at one time or another considered the application of motion pictures to their businesses, and many have adopted it. Some, through lack of a proper study of the subject, have vetoed it. But in this new device we have the greatest medium for commercial story-telling that the world has ever seen, and men are beginning to recognize the opportunity it offers. The greatest advantage lies in the fact that the motion picture visualizes the salesman's story—for the motion picture is not dependent on words. It knows no tongue, country or season, but tells your story as you would have it told, in the universal language of action. Action demands attention, and to secure attention is the first essential in making a sale.

The time is coming, therefore—and it is well for electrical manufacturers and central station men to think about this now—when the salesman will use the moving picture instead of photographs. In selling motor service he will call upon his "prospect" by appointment, carrying with him a portable moving-picture projector set, which will be set upon the desk, and as the salesman talks he will be showing moving pictures of electric-motor appliances, thrown upon the wall. What better presentation could be made?

An ordinary photograph is quite inadequate, because it is the action of the motor that the man is buying—the work it does is what he wants—and except in motion pictures this action cannot be demonstrated unless the prospect visits many installations, which he will not do. This use in motor-service sales will probably be the first step in the adoption of the motion picture as an influence in the sale of electric service—but the same condition applies to many other appliances as well. The washing machine, for instance, cannot be carried around from house to house. The moving picture can and will tell the story to the housewife in as interesting a way as though she watched the appliance herself. It will be no less useful in demonstrating the other devices, and there will be no difficulty in gaining a hearing in any house. But the picture must be worth seeing to insure carrying your message to the world at large.

TO DEMONSTRATE DETAILS

Whether it be a question of stimulating sales directly to the consumer, or of selling factory equipment or installations, the motion picture has no equal as an aid to the salesman, for its superiority lies in the fact that it compels concentration on the story it tells. The entire sales argument is told in a dignified, forceful manner, with every detail emphasized.

Portable, fireproof projecting machines are now available, which use a special non-inflammable film. Such a machine may be demonstrated in any office or room, projecting the picture on a small screen or light wall.

Consulting engineers who have been questioned on the subject have been quick to recognize the possibilities of motion-picture salesmanship, readily conceding how much of their time could be saved by having installations, machinery, etc., demonstrated to them in their offices. And what applies to engineers is likewise applicable to the other busy men who, although willing, lack the time to go on tours of inspection. All this demonstrates the great potential sales value of the motion picture as a medium for establishing a closer relation between the manufacturer and the buyer.

The motion picture visualizes the salesman's story—for the motion picture is not dependent on words—it tells its story in the universal language of action.

Experience Shows Electric Cooking to Be a Profitable Day Load in Illinois Communities

In the course of the paper on "Electric Cooking" presented before the Illinois State Electric Association at Champaign by J. Paul Clayton of Mattoon, Ill., Mr. Clayton said in part:

"There are about 625 towns in Illinois receiving electric service, and of these towns only 225 are supplied with gas. There are, therefore, 400 towns where electric cooking can be successfully developed with electric rates low enough to make this form of cooking an economic success. It is estimated that in Illinois there are 80,000 residence customers now using electric lighting who have no gas available. The average annual income from an electric-range customer amounts to about $36. The total possible income from electric cooking if every residence customer could be supplied would, therefore, amount to $2,880,000 per year.

"Our company, the Central Illinois Public Service Company, has kept records of the monthly energy consumption of 150 cooking customers divided among fifty towns. The average consumption per customer by months for the last six months of 1915 was as follows:

	Kw.-hr.
July	99.8
August	89.8
September	93.3
October	108.0
November	101.6
December	106.1
Average per month for all customers	101.7

"This average is not the arithmetical average of the above figures, but is the weighted average for all customers.

"In order to develop cooking to any large extent in Illinois, it is necessary to offer rates of from 3 cents to 4 cents per kilowatt-hour for residence cooking and of less than 3 cents per kilowatt-hour for restaurants, hotels and other cooking customers using large amounts of energy.

"When we first started selling electric ranges we kept a very accurate account of all the expenditures necessary to serve each range. The total cost per range of connecting thirty ranges in fifteen towns with the price of copper as it was one year ago was as follows:

	Per Customer
Line extension (primaries and secondaries)	$5.26
Service drops (additional investment)	2.29
Transformers	6.12
Meters	7.91
Total additional expenditure	$21.58

"In connecting the above thirty customers it was necessary to increase the transformer equipment in only eight cases. The remaining twenty-two customers were served from the transformers already serving lighting customers in the immediate vicinity. Our experience to date seems to indicate that the average additional expenditure per cooking customer for line extensions, service drops, transformers and meters will not average more than $30 per customer, although we have had a few installations that cost as much as $50 to $60 per customer. We find that transformers must be changed for about 25 or 30 per cent of the cooking customers taken. The electric-range load is diversified in the same way as the lighting load to a very large extent.

"In order to make cooking by electricity successful, it is very necessary that the service to each range be carefully planned, so that there is full voltage at the range. We have had one case where the voltage on a number of ranges fell to about 10 per cent below normal and the consumption of the ranges was very much increased from this cause, resulting in dissatisfaction from high bills.

"When we first commenced selling ranges we found that many of the company's employees did not really believe in electric cooking but felt that its cost would be so high it would be prohibitive. Many of our prospective customers ask why the employees of the company do not use electric cooking if it possesses such advantages as we claim. We held a meeting of our salesmen and superintendents of our principal towns and had the different range manufacturers demonstrate their ranges and actually cook a dinner for these men. This meeting entirely changed the feeling of our employees toward electric cooking. We then started on a campaign to secure as many employees of the company as possible, as we found that when an employee becomes a range customer he also becomes a very active salesman.

"In conclusion, it may be said that when a lighting customer purchases a range the income from the customer is tripled. The additional investment necessary to serve the range is in most cases not so large as the original investment in distribution system necessary to serve the customer with lighting service only. It is thus apparent that the additional income from cooking must result in greatly increasing the gross earnings which can be secured from a residence-lighting distribution system without proportionately increasing the investment. The electric-cooking load offers practically the only hope of materially increasing the earnings in towns where electric-power load is not available, as is the case in many small towns."

The Advisability of Special Rates for Cooking

In the discussion on electric cooking, J. P. Ingle of Keokuk, Iowa, declared that the practice of giving customers two rates, one for lighting and one for cooking, without restricting the hours' usage of the equipment, would cause electric companies' patrons soon to demand the lower rate for both lighting and cooking. He cited the unfortunate experience gas companies have had with different rates for lighting and for cooking as a case in point. He also expressed the opinion that electric cooking is an on-peak load.

Mr. Ingle's arguments were answered by J. G. Learned of Chicago and K. A. Steinhauser of Nashville, Ill. Mr. Learned said that the present trend of rates is downward and that developments in the art of generation and distribution probably will, by the time a single-rate system is demanded, allow companies to sell energy for 3 cents per kilowatt-hour at a profit. He also pointed out the fact that the large meal of the day in small towns is cooked at noon when the central-station load is low. Mr. Steinhauser, who has forty range customers in a town of 2500 inhabitants and has been selling energy for cooking at 3 cents for about five years, said that three of every ten ranges installed operate on the peak while the remainder take off-peak energy.

Everything Sold but the Electric Sign

The merchandising value of the electric sign was recently demonstrated in Toledo by the Home Furniture Company. This concern was about to move to a new store and headed its newspaper advertisements with the statement: "The only thing we will carry with us after this removal sale is over is the electric sign on our building." The sign was also illustrated in the "ad." The Toledo Railways & Light Company promptly took advantage of this gratuitous advertisement of an electric sign's value.

ADVANCE IN TECHNICAL THEORY AND PRACTICE

Including a Digest of Important Articles Appearing in the Scientific and Engineering Press of the World

Construction of an Electrostatic Voltmeter

Features of a Device for Measuring Potentials Up to 75,000 Volts Used in Connection with the Cottrell Process of Electrical Precipitation of Smoke and Fumes

BY E. R. WOLCOTT

AN electrostatic voltmeter for measuring potentials such as are used in the Cottrell process of electrical precipitation of smoke and fumes, which may readily be used to give the root-mean-square values of either direct or alternating current voltages up to 75,000 volts, has been developed in the laboratories of the Western Precipitation Company of Los Angeles.

As shown in the accompanying illustrations this voltmeter has been constructed on the principle of the Kelvin guard-ring electrometer which can be readily calibrated, as the force of electrostatic attraction is balanced by a known weight and the reading is taken in absolute c.g.s. units.

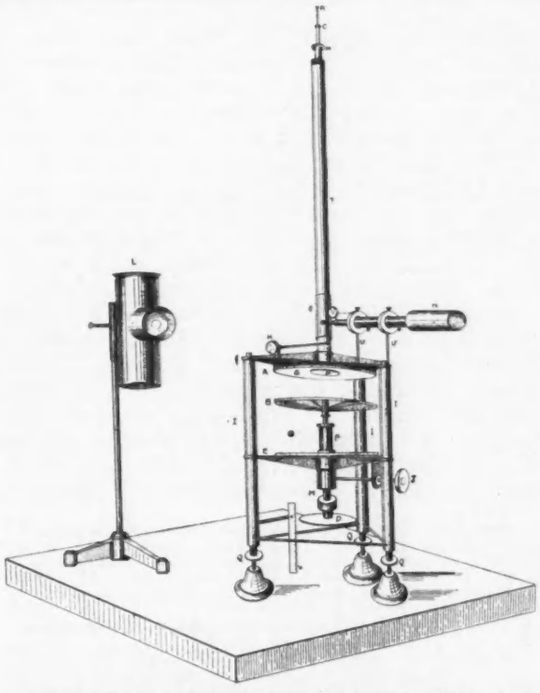


FIG. 1—ELECTROSTATIC VOLT-METER, SHOWING HIGH-POTENTIAL AND GROUNDED PLATES

As shown in Fig. 1, A and B are two conducting surfaces, A being connected to the source of high potential and B to ground. M is a micrometer screw for adjusting the distance d between A and B. The surface A consists of two parts, the rigid guard ring and the movable plate P which is hung from spring S (see Fig. 2) mounted in the tube T. These two plates are normally in the same plane.

If the spring S be so adjusted that a certain upward force F be exerted on the plate P, having an area p, which is at a distance d from the plate B, then the emf. in volts that must be applied to A to again bring P into the plane of G equals

$$e = k\,d\,\sqrt{\frac{8\pi f}{p}}$$

where k is the constant of transformation from electrostatic units into volts and is approximately equal to 300.

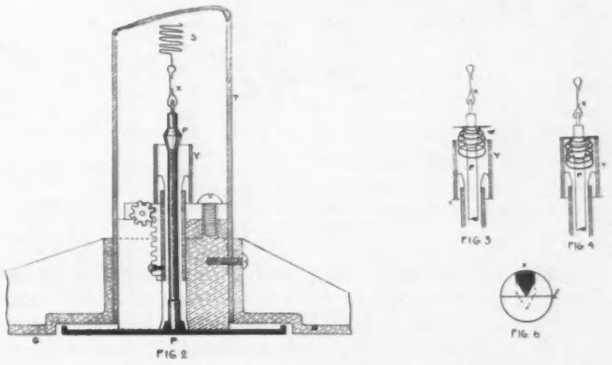
This relation holds only when the diameter G is large compared to that of P and when the distance d is not too large as compared to P. An experimental determination of these limitations may be expressed as follows:

$$R : r : d :: 8 : 3 : 12$$

where R is the diameter of the plate G, r is the diameter of the disk P and d the distance between A and B.

The instrument is calibrated by means of a known mass, that is the platinum spiral w, which may be added to or removed from the plate P by the knurled head K which lifts the hollow cylinder Y so that the mass w rests on it, as shown in Fig. 4, instead of on the shoulder F, as shown in Fig 3.

Referring to Fig. 1, R is a small rod from which is suspended a spring, S, and which is securely held by the clamp C. The knurled head H permits of fine adjustment in raising and lowering the plate P, which is suspended from the spring S (see Fig. 2). The brass tube T incloses spring S and has two opposite windows, O, near its lower end, through which a beam of light from the lamp L passes. By means of the microscope supported at U and U' a magnified shadow of the tip of the loop X is focused on the translucent screen, as shown in Fig. 6. N is a hollow cylinder of hard rubber to darken the translucent screen and at the same time prevent the observer from getting too close to the highly charged upper part of the instrument. The insulating supports (I-I-I) are of hard rubber. E is a fixed plate which supports the movable plate B. J is a knurled head for rapid adjustment of the plate B, as shown in Fig. 5. Fine adjustment may be obtained by turning the micrometer screw at M. D is graduated disk which indicates the distance E between plates A and B on the scale V and may be calibrated to read directly in volts. Q-Q-Q are levelling screws.



FIGS. 2, 3, 4 AND 6—DETAILS OF HIGH-POTENTIAL ELEMENT, SHOWING SPRING AND WEIGHTS

The method of operation is as follows:

The instrument is levelled so that the plate P swings

freely. *B* is then moved up to make contact with *A* and the disk *D* and scale *V* set to read zero. The microscope is adjusted so that the tip of the shadow of *X* touches the line *L* on the translucent screen, as shown in Fig. 6.

The plate *B* is then lowered and the mass *W* (in this case 514 mg.) allowed to rest on the shoulder *F* by lowering the hollow cylinder *Y* by means of the knurled head *K*, as shown in Fig. 3. The tension of the spring *S* is adjusted at *H* so that the tip of the shadow of *X* again touches the line *L*, Fig. 6. The knurled head *K* is then turned so as to lift the spiral from *S*, as shown in Fig. 4. The plate *P* ascends a short distance and the instrument is ready to use. The upper part of the instrument is then connected to the high-tension source and *B* is grounded or connected to the opposite terminal of the high-tension source, if so desired, as *E* is also insulated.

The electrostatic attraction causes plate *P* to move toward *B*. *B* is then adjusted so that the tip of the image of *X* again touches the line *L*. The electrostatic attraction between the disks *P* and *B* is then equal to the attraction exerted by gravity on the mass *W*. By

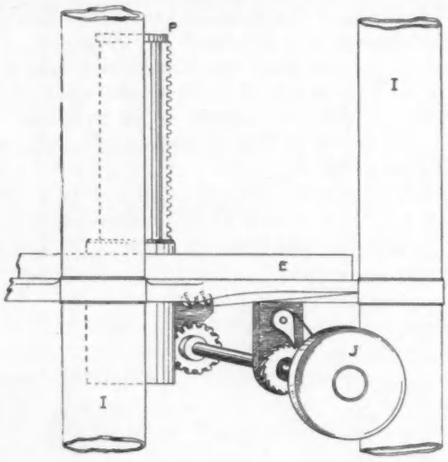
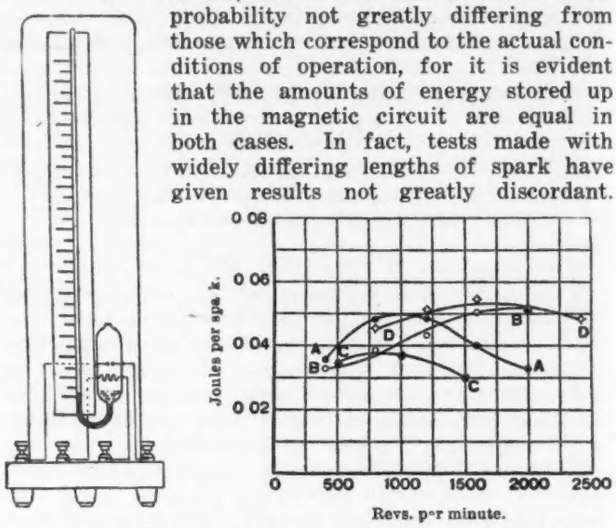


FIG. 5—RACK-AND-PINION ELEVATING MECHANISM FOR ADJUSTING PLATE B

substituting the values *d*, *f* and *p* in c.g.s. units in the formula, the readings in volts is determined or the scale may be calibrated to read volts directly. Repeated tests of this instrument have demonstrated its accuracy to 1/10 of 1 per cent.

Generators, Motors and Transformers

Ignition Magnetos.—D. NOBILI and G. CAMPOS.—With reference to the recent article of Armagnat, the authors give the results of experiments in which they determine the energy output of ignition magnetos for automobiles. It being necessary to avoid wattmeter methods and generally every method based upon the use of circuits directly connecting the high-pressure terminals in any way whatever, the authors adopted a direct method for measuring the energy of the spark, with the help of a calorimeter. The instrument employed for this purpose (Fig. 7) had a bulb filled with nitrogen at atmospheric pressure, containing a spark gap with platinum points and a spiral of resistance wire, the latter being connected to an independent circuit and serving to calibrate the instrument with direct current. To any given height of the mercury column there corresponded a definite expenditure of energy, derived either from the heating of the spiral wire or from the spark passing between the platinum points. The speed of operation or rotation of the magneto gave the number of sparks per second. The conditions of work of a magneto in connection with the calorimeter are obviously different from those under which the ignition spark passes in the cylinder of an internal-combustion engine, where the discharge takes place in inflammable gas under pressure; it is possible, however, not only to compare the performances of different magnetos by this means, but also to obtain results in all probability not greatly differing from those which correspond to the actual conditions of operation, for it is evident that the amounts of energy stored up in the magnetic circuit are equal in both cases. In fact, tests made with widely differing lengths of spark have given results not greatly discordant.



FIGS. 7 AND 8—INSTRUMENT USED AND RESULTS RECORDED

Measurements carried out with four snap magnetos for aviation motors at various speeds gave the results shown in Fig. 8; other tests, made on magnetos, with rotating armatures, are shown in Fig. 9. These curves indicate that, at any rate in the case of the types of magneto experimented on, the energy per spark remains practically constant from low to high speeds, or, in some cases, attains a maximum at a particular speed. The authors state, also, that the minimum and maximum values obtained for the energy of the sparks are included between the limits calculated by Armagnat for the energy available in the magneto; they are, however, far removed from his maximum limits, showing that the apparatus has a low electrical efficiency. This is not a serious drawback, owing to the small quantity of energy that suffices for the ignition of even large engines; nor is it surprising, seeing that in the case of such a generator of electrical discharges, which are probably oscillatory, a large proportion of the energy is

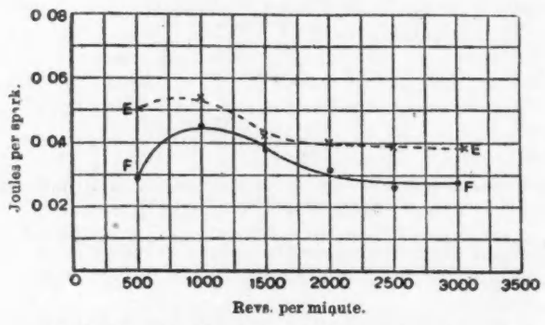


FIG. 9—ENERGY OF SPARKS, ROTATING MAGNETOS

dispersed in the metallic masses.—*Le Revue Elec.*, March 3, 1916; translated in abstract in London *Elec. Review*, April 21, 1916.

Transformer Design.—F. M. DENTON.—The first parts of a mathematical article in which a general discussion is given of the nature of the problem of transformer design. The author sets out Arnold's method of design for constant-potential transformers. He then deals with the conditions insuring maximum electrical

and commercial efficiencies, and discusses the advisability of designing power transformers for minimum cost. A rule is developed by the aid of which designs of power transformers may be based upon commercial efficiency rather than upon minimum cost. The author then gives an outline of the method of design proposed by Arnold in 1910 and a comparison of Arnold's later and earlier methods. Comparative designs are worked out and a schedule is given, based upon Arnold's method of 1904. The article is to be continued.—London *Electrician*, April 14 and 21, 1916.

Generation, Transmission and Distribution

Large Projected Water Power Plant.—OSKAR VON MILLER.—The first part of a long report on the projected Walchen Lake water-power plant. After a considerable amount of power has been reserved for future electric operation to railways, this plant will be able to furnish yearly 120,000,000 kw.-hr., with a maximum power of 40,000 kw. It is proposed not to utilize this power in a district of limited area, but to place it at the disposal of all the Bavarian electric supply stations. It is suggested that the different existing electric stations and transmission systems combine and form a large corporation, the "Bavarian Works." These are to erect a high-tension networks over the whole district of Bavaria at the right hand of the Rhine. This transmission system will be supplied from the Walchen Lake works and other government-generating plants or private generating plants. It is figured that about 20 per cent will be saved in cost of generating electricity by combined operation of all plants.—*Elek. Zeit.*, Feb. 17, 1916.

Hoisting Controllers for Large Electric Revolving Cantilever Cranes.—In this article illustrated descriptions are given of two controllers used for the hoisting motors of the large electric revolving cantilever cranes, which have been installed in large numbers for the fitting out of ships. Of these controllers one is of the drum type and the other is of the magnet-switch type. Carefully drawn diagrams of connections illustrate the article.—London *Electrician*, March 24, 1916.

Moisture in Gas Coke.—PAKENHAM BEATTY and A. F. SMITH.—After the war began the supply of Welsh coal to Argentina was cut off and it became necessary to operate the tramway power station of Buneos Aires with gas coke as fuel. Figures of analysis and fuel consumption are given and it is pointed out that there is an enormous increase in fuel consumption per kilowatt-hour whenever moisture is present in the coke. Curves are given showing the increased coal consumption. Six per cent would appear to be the minimum amount of moisture gas coke is likely to contain, even in dry weather. With this amount of moisture, one ton of coke occupied 2.45 cp. m. as against 1,1 cp. m. in the case of the Welsh coal usually burned. In other words, one ton of coke occupied about 2.25 times more space than Welsh coal, and the extra work entailed was the cause of some complaint from the stokers. The highest rate at which coke containing 6 per cent of moisture was burned reached 18 lb. per square foot of grate area per hour, but when the moisture rose to 20 per cent, as much as 23 lb. per square foot of grate area had to be consumed in order to keep pace with the load.—London *Elec. Review*, April 14, 1916.

Electricity in British Mines.—An abstract of the annual report of 1914 of the British Chief Inspector of Mines. There are employed in mines in the United Kingdom 294,000 hp. of surface motors, 420,000 hp. of underground motors, or a total of 714,000 hp., which is an increase of 13.64 per cent over the preceding year. Data are given on electric accidents, electric coal cutting machines, shot firing, and electric safety lamps.—London *Elec. Review*, April 21, 1916.

Installations, Systems and Appliances

Large Storage-Battery Substation.—An illustrated description of a new storage-battery substation of the Metropolitan Electric Supply Company of London. It consists of 110 cells with an ampere-hour capacity of 12,000 amp.-hr. if discharged for ten hours at 1.8 volts per cell, or 10,000 amp.-hr. for five hours at 1.78 volts, or 7600 amp.-hr. for two hours at 1.17 volts, or 6000 amp.-hr. for one hour at 1.65 volts. The weight of the complete battery, exclusive of stands is 298 tons 11 cwt. Two motor-driven boosters are used, each consisting of one interpole motor of 115 hp., 210/240 volts at 500 r.p.m., and two interpole boosters, the fields of which can be reversed so as to boost up or down, each capable of giving 1800 amp. at 16.7 volts continuously, 2500 amp. at 12 volts for two hours, and 3000 amp. at 10 volts for one hour, the boosters being separately excited off 210/240 volts, and each having one commutator which is ventilated through slots in the center of the commutator between two steel rings. One battery milking booster has also been installed, consisting of an interpole motor for 220 volts, connected through a flexible coupling to an interpole booster giving 1500 amp. at 10 volts when running at 575 r.p.m.—London *Electrician*, April 14, 1916.

Telegraphy, Telephony and Signals

Relay for Wireless Telegraphy.—An illustrated description of a new relay which is claimed to be superior to Dary, Ducretet and Brown's relays with respect to natural frequency and sensitivity. As described by E. Leimer, the instrument (Fig. 10) consists essentially of a separately excited pot magnet, in the narrow air gap *d c* of which there is a coil, *e*, consisting of several hundred turns of No. 50 insulated copper wire, wound in one layer on a pot-shaped celluloid former, which is carried by fine metal wires *f*, *g*, serving also as leads. The celluloid former moving with small clearance on the center pole *c* provides damping, and the wires *f*, *g*, terminating on torsion and tension screws provide a free suspension adjustable for sensitivity and frequency. Either a third wire parallel to *f* or *g* (in which case torsion screws are unnecessary), or a fine wire spiral carries relay current to a platinum contact *i*, opposite which is an adjustable contact screw *k*. The relay is in effect a thread galvanometer, and is connected in the detector circuit. It can be made to respond to 4 microamperes when adjusted to a natural frequency of one-half second. In normal working, natural frequency and sensitivity are adjusted, so that certain relay contact is made with about 25 microamperes in the moving coil. Limiting the permissible heating of the coil *b* to 40 deg. C. in half an hour, a field of about 18,000 gauss is obtainable in the gap *d*, *c*. Varying this field provides 1:1.5 or so variation in sensitivity, and the latter can be more than doubled again by the use of 0.02 mm. silver wire, instead of 0.3 mm. copper wire, in the coil *e*. Such fine silver wire can be insulated sufficiently for the present purpose by coating with a carbon-bisulphide lacquer, or by blackening in solutions containing carbon-bisulphide or sulphuretted hydrogen. In this and similar relays certain precautions are necessary to prevent sticking at the relay

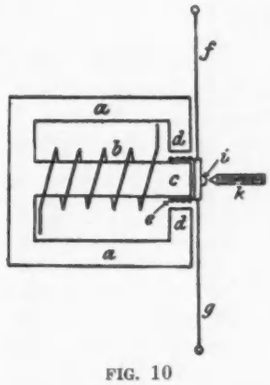


FIG. 10

contacts. The moving contact should be a domed disk of burnished platinum of very small diameter, and the stationary contact should be tipped with a fine platinum wire, pointed and polished. The whole instrument should be spring-suspended under a dust-tight glass bell, and the local current controlled by the relay contacts should not exceed 100 microamperes at 1.5 volts; this current may be used to operate a step relay actuating a Morse printer. The inductance of the step relay must be neutralized by a non-conductive resistance in parallel and by a condenser across its contacts. Only by this means and by removing the step relay, Morse printer and current-carrying leads as far as possible and by bifilar winding of the spiral connecting to the contact *i*, can the main relay be kept reasonably free from outside influences when set to maximum sensitivity. The sensitivity of the primary relay may be appreciated from the fact that it records the ringing of a house bell, whose circuit passes 25 ft. away from the wireless installation, and the starting and stopping of electric tramcars 500 yd. away. The relay is only suitable for use with electrolytic detectors; crystal detectors give no results. By using two or more electrolytic detectors in parallel the relay can be made to record signals which do not affect it when a single detector is used.—London *Elec. Review*, April 21, 1916.

Book Reviews

OXY-ACETYLENE WELDING AND CUTTING. ELECTRIC FORGE AND THERMIT WELDING. By Harold P. Manly, Chicago. Frederick J. Drake & Company. 56 illustrations. 216 pages. Price $1.

As a practical treatment of the several processes of welding this book is applicable to the needs of the workman. Because of its small size and the large number of subjects treated, the subject matter is brief and to the point; but not inadequate. Besides a thorough treatment of practical welding, the reader will find here for easy reference practical information on metals; alloys; gas generation, handling and use; welding instruments, parts and appliances; and other miscellaneous but useful data. The large number of illustrations employed have been carefully chosen and add materially to the value of the book.

SAFETY ENGINEERING APPLIED TO SCAFFOLDS. Published by the Travelers Insurance Company, Hartford, Conn. 354 pages. Illustrated. Price $3.

In the construction of buildings nothing is more essential than scaffolds and labor, and these two are so intimately related that without the one the other could not operate, and just in proportion as one is stable the other is efficient. The author treats of all kinds of scaffold construction and appliances. The book is printed in large type and presents the subject in a most interesting and logical manner, illustrated with drawings and photographs of actual conditions which have obtained both in this country and in Europe. In addition to describing sound methods of scaffold construction, it makes a particular point of describing unsound methods and advising what to avoid; thus making the material doubly instructive. The work merits wide distribution, and anyone interested directly or indirectly in building construction will find in it much of value.

THE UNIVERSE AND THE ATOM. By Marion Erwin. New York: B. Van Nostrand Company. 314 pages, 58 illustrations. Price, $2.

This is not a text-book, but an original contribution to scientific theory, the theory of the ether, the structure of the atom and the nature of gravitation itself. The ether, we are told, is a substance just as a matter is a substance, the essential difference between the two being that the matter has the additional property of attraction. Various familiar experiments are mentioned to make it somewhat less difficult for the reader to conceive that "matter itself is nothing more than ether in a different form of motion or vibration from what it is undergoing in the depths of space," page 3.

Unlike many thinkers of the present day who believe in the electrical nature of matter, our author goes one step further when he endeavors to show that electricity itself is only a "mechanical operation involving the particle structure and particle motion in the ether," page 232. Electricity is, therefore, not the ultimate "thing" in nature, for to consider the electron as an atom of electricity and treat it as the ultimate *thing* "leaves us but a little better off than were our early scientists who explained fire by the escape of 'phlogiston' from matter," page 234.

We are glad to find, on page 282, a clear definition of an ether particle as "an eddy" or "whirl" of substance, the center of which is itself revolving around a center, the whole thus forming a particle of the First Order. To this is added that "the eddy or whirl is a particle of the Second Order." There are other particles of the "Third Order," etc., down to the infinitesimal.

When Newton discovered universal gravitation and announced its laws of action about 250 years ago, he was careful to add that he knew not the why of such a force. Since then, explanations have been offered from time to time, none of which commanded wide or final acceptance. It is to be hoped, however, that the explanation of this great mystery of nature which the author presents in Chapter XX—artificial and involved as it reads—will meet with a better fate.

DIE LEHRE VON DER ENERGIE (The Doctrine of Energy). By Alfred Stein. Leipzig and Berlin, Germany: B. G. Teubner. 130 pages. Thirteen illustrations. Price 1 m. 25 pf.

This little volume contains an elementary exposition of the doctrines of the conservation and conversion of energy in a form readily capable of being understood by the non-technical, intelligent reader.

The five chapters of the book deal respectively with the following topics: the concept of energy, forms of energy, the sun as an energy center, perpetual motion, the movement of energy.

The chapter on the fallacy of perpetual motion gives an outline of the history of that very fascinating subject.

The book is a welcome addition to the cultural literature of elementary modern science.

Books Received

VALUE FOR RATE-MAKING. By Henry Floy. New York: McGraw-Hill Book Company, Inc. 322 pages. Price, $4.

INDUSTRIAL ARBITRATION. By Carl H. Mote, Indianapolis: The Bobbs-Merrill Company. 400 pages. Price, $1.50.

W. S. GIFFORD

Men of the Industry

Changes in Personnel and Position—Biographical Notes

Walter S. Gifford, who as supervising director of the committee on industrial preparedness of the Naval Consulting Board of the United States is making a minute inventory of American industry with the assistance of more than 30,000 American engineers, is the statistician of the American Telephone & Telegraph Company. Mr. Gifford was born at Salem, Mass., in 1885, and was graduated from Harvard in 1905. Joining the staff of the Western Electric Company at Chicago as a clerk in the payroll department, he later became assistant secretary-treasurer of the company at New York, having charge of the accounting in the New York factory and Eastern distributing houses. In 1908 Mr. Gifford became statistician to the American Telephone & Telegraph Company, and under his direction the department has become probably the largest business statistical office in the country. Mr. Gifford is chairman of the committee on business statistics of the American Statistical Association, and has presented papers before a number of economics and statistical gatherings.

Herbert H. Berry has resigned his position as superintendent of the Yarmouth (Me.) Lighting Company.

C. G. Hanna of Clinton, Ind., has been appointed manager of the Sullivan (Ind.) County Electric Company.

D. H. Couch has resigned as manager and chief engineer of the Mayaguez Light & Ice Company, of Mayaguez, Porto Rico, and returned to New York on May 5 on the steamer Zulia. He plans to enter central station work in the United States, although he has not yet settled upon definite arrangements. His mail address temporarily is in care of the A. I. E. E., New York City.

William J. Hagenah, public utility engineer of Chicago, and Halford Erickson, formerly chairman of the Railroad Commission of Wisconsin, have announced the formation of a partnership under the name of Hagenah & Erickson, with offices in the First National Bank Building, Chicago, for the purpose of conducting railroad and public utility investigations, appraisals, cost analyses, rate studies and financial investigations. The firm plans to engage in general practice before public service corporation regulatory bodies.

J. R. Wilson, formerly sales manager and vice-president of the Crocker-Wheeler Company of Ampere, N. J., has become associated with the Davison Chemical Corporation of Baltimore, Md., as manager of its office at 120 Broadway, New York City.

Grenville A. Harris has resigned as chief engineer for Takata & Company, 50 Church Street, New York City, with whom he has been connected for sixteen years, and has been appointed chief engineer for the American Steel Export Company, Woolworth Building, New York City, where he will have entire charge of the company's newly established engineering and machinery department.

C. W. Levalley has retired as president of the Chain Belt Company of Milwaukee, Wis., and has been made chairman of the board of directors. Mr. Levalley founded the company and has been its president and general manager since 1891. The concern was started in a small room, making detachable chain belt for farm implements. Later it branched out into making special chains of the riveted roller type, and gradually entered the elevating and transmission machinery field.

Obituary

William T. Wheeler, secretary and treasurer of the Port Jefferson (L. I.) Electric Light Company, died as the result of an electric shock in the company's plant on May 3. Mr. Wheeler was sixty-four years of age and was unmarried.

Henry N. Foster, traffic superintendent of the Chicago Telephone Company, dropped dead at Winnetka, Ill., on May 4, while directing a moving-picture scene illustrating the operation of the modern telephone. Mr. Foster was well known among the electrical men of Chicago. He was 42 years old at the time of his death.

Henry Floy, electrical engineer and valuation expert, died suddenly at his residence in New York City on Friday, May 5. Mr. Floy, who had been acting for the United States Department of Agriculture in the case now pending against the Yosemite Power Company with respect to the Hetch-Hetchy water supply, had been a figure in many important public utility cases during the last twenty years. Mr. Floy was a graduate of Cornell, class of 1891, and during several years following graduation served with the Westinghouse company in its shop, engineering and sales departments. He resigned as manager of the Minneapolis office of the company in 1898 to open an office as consulting engineer in New York City, where he had since been located. Mr. Floy installed the first 25,000-volt underground transmission line at St. Paul, Minn., in 1900. Later he acted as arbitrator in the Colorado Springs (Col.) lighting controversy, and also served in many important appraisal cases in New York City; Buffalo, N. Y.; Springfield, Mo.; Tucson, Ariz., etc. He has been a frequent contributor to the technical press, and is the author of a number of volumes, including "The Colorado Springs Lighting Controversy," "High-Tension Underground Electric Cables," "Valuation of Public Utility Properties" and (recently issued) "Value for Rate Making."

HENRY FLOY

Prof. Lucien Ira Blake, inventor of the submarine signal and of the electrostatic ore separator which bears his name, died at Boston, Mass., on May 4. He was born at Mansfield, Mass., in 1854, and studied under Helmholtz and Hertz at the University of Berlin, from which he received the degree of doctor of philosophy in 1883. He was professor of physics and electrical engineering at Rose Polytechnic Institute, Terre Haute, Ind., from 1884 to 1887, and occupied a similar chair at the University of Kansas from 1887 to 1906. Professor Blake began his experiments in submarine signaling at Newport, R. I., in 1889, and was granted facilities by the government at Sandy Hook and at the Portsmouth (N. H.) Navy Yard. The famous frigate Constitution was used in his work. From small beginnings the apparatus has been developed to a point where it is widely used in both naval and mercantile shipping, the demand for this equipment having been greatly stimulated by the European war. In recent years Professor Blake had spent much time abroad, returning to this country two years ago to give lecture courses at the University of California, in Colorado and elsewhere. He developed the electrostatic ore separator in conjunction with a student named Morscher at the University of Kansas. Professor Blake was a member of many scientific societies. He is survived by his widow and a brother, Percy M. Blake, who is a consulting engineer in Boston.

NEW APPARATUS AND APPLIANCES

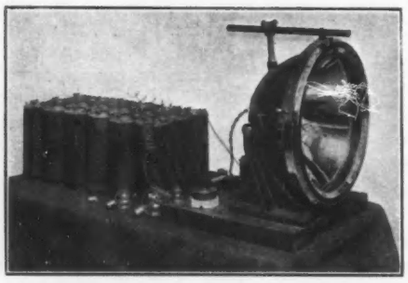
A Record of Latest Developments and Improvements in Manufacturers' Products Used in the Electrical Field

Triangulation Signal Lamp

State, county and city surveyors must look to the national government for the exact geographical positions upon which to base their respective surveys. The duty to establish and furnish these positions devolves upon the United States Coast and Geodetic Survey.

The geodetist determines astronomically with the greatest possible exactness the longitude and latitude of selected principal points, suitably distributed over the whole country. The geographical positions of the many places between these principal points required are ascertained most accurately and economically by means of what is called triangulation. A rough, preliminary or reconnaissance survey reveals those points which are intervisible and most desirable as to distance and other characteristics, to form the corners of connected triangles. From the measured length of one side of a suitably selected one of these triangles and the angles of all the interconnected ones, the exact latitude and longitude of each point is computed.

Though the general principle employed in the measurement of these angles is the same as that applied in



DRY-BATTERY-OPERATED SIGNAL LAMP FOR TRIANGULATION SURVEYS

the survey of a railroad, a farm, etc., the great distance between the points, varying between 10 and 100 miles or more, requires not only the use of specially large and refined instruments, but also a special means of making the point visible to the observer. This latter is now done, in day time, by reflecting sunlight to the observer from a mirror placed accurately over the point, and at night by means of a specially constructed acetylene lamp.

It is apparent that distances of the magnitude mentioned can be penetrated by either means only under favorable weather conditions, and that many days during a season are lost even when the atmosphere is only slightly clouded by smoke, fog, etc. As the expense to maintain the party, which amounts to from $50 to $60 per day, goes on whether observations are made or not, it was thought that advances in illuminating devices made since the lamp now used was adopted might be utilized to increase considerably the intensity of the light directed to the observer, and thereby increase the number of observing nights.

Experiments made with calcium light produced by the oxy-acetylene flame showed this form of illumination to be impracticable by reason of cost and bulkiness of the apparatus necessary.

The storage cell was studied with the view of using electricity as a source of light. Its cost and weight and the difficulties connected with its maintenance were found to be too great. The electric generator with the necessary prime motor were carefully studied, tried experimentally and found to be too heavy for transporting to difficult stations, and doubtful as to continued and unfailing service.

The result of a series of tests of dry cells, which are readily divisible into loads suitable for climbing difficult ascents, however, warranted the design and construction of two new lamps, the use of which, undoubtedly, will increase the present number of observing nights per month by at least 25 per cent.

The main part, an ordinary automobile headlight, is suitably mounted for directing in the horizontal and vertical; the lamp is provided with an ammeter, a small rheostat and a switch. The whole, packed in a strong case, weighs 23.5 lb.

In order to obtain most nearly the maximum intensity of the light, it was necessary that the lamp bulb be provided with a filament concentrated to a degree not found in those on the market. The H. W. McCandless Company, New York, was induced to make the necessary designs and experimental tests, and submitted a number for trial.

At the present time all the lights of the stations surrounding the observer's station are kept burning continuously from sunset to the closing of the observations for the night. The use of the dry cell was found practicable and not too costly on the assumption that the proposed lamp was to be kept burning throughout the night. The trial of the newly-designed lamp by comparison with the present acetylene lamp, however, proved the former so much superior, that it was decided to have the lights shown only on signal, flashed with one of the new lamps by the observer, for the few minutes each time it is observed upon. This reduces very materially the consumption of current and battery cost.

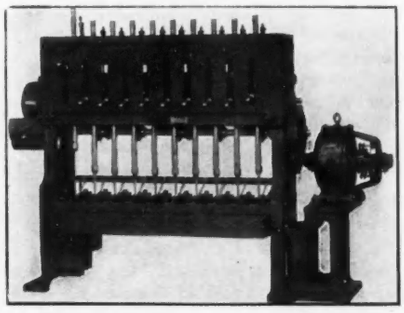
The lamp, after being provided with two additional bulbs, one for medium and one for short distances, was tested by the Bureau of Standards, with the following results:

Apparent candle-power, at a distance of 100 ft.—Lamp with special concentrated filament gas filled, 6 volts, 2.5 amp.	250,000
Automobile lamp, 6 volts, 1.8 amp.	50,000
Flashlight lamp, 2.7 volts, 0.34 amp.	6,000

The candlepower of the acetylene lamp now used in the triangulation carried on by the Survey, measured under the same conditions, is 1500. The reflector used for the lamp is of the 11-in. "Old Sol Searchlight No. 111" type, made by the Hawthorne Manufacturing Company, Bridgeport, Conn. The new lamp was developed by E. G. Fisher, chief of instrument division, Coast and Geodetic Survey.

Motor-Driven Nut-Tapping Machine

The ten-spindle automatic nut tapper shown herewith and developed by the National Machinery Company of Tiffin, Ohio, is designed to handle hot-



ELECTRIC TEN-SPINDLE NUT-TAPPING MACHINE

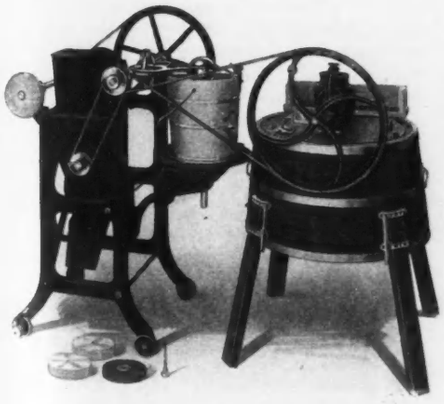
pressed nuts as readily as cold-pressed ones. Furthermore, there is no chance of the nuts sticking, it is declared, as is frequently the case with entirely automatic nut tappers. In this machine the spindles are raised and lowered automatically by cams, the sole duty of the operator being to feed the blank nuts into the machine and to empty the taps. By operating the machine without treadling, tap breakage is greatly reduced, as the cam movement lowers the spindles gradually. This eliminates the sudden and violent tap strains incurred in the "foot lever" tapper, when from fatigue or through negligence the operator allows the spindles to drop, causing the tap to jam and bind, and subjecting it to excessive torsional strains that result in breakage. The tap spin-

dles are close together, being within a space of 70 in., thus enabling the operator to feed successfully ten spindles. The spindles can be adjusted vertically to suit various lengths of taps, and the taps can be removed or inserted in the sockets without stopping the machine.

Ten three-step cams are used to raise and lower the spindles, and are so timed that the raising and lowering movements are in consecutive order. The camshaft can be shifted laterally to engage the various cam steps. In this way the resting time of the spindles when raised can be changed to meet the needs of the operator for feeding and emptying the taps. The illustration shows one of these machines geared to a Westinghouse, adjustable-speed, direct-current motor. By means of a drum control the speed of the motor operating the camshaft may be adjusted from 550 r.p.m. to 1200 r.p.m., making the machine suitable for tapping nuts from 0.75 in. to 0.5 in. in size. This control allows the revolutions of the tapping spindle to be varied to suit the number of threads on the tap used, thus obtaining maximum production from the machine. These speed changes can be made while the machine is running.

Adapting the Household Motor to Many Uses

An interesting adaptation of motor drive to the operation of a small ice-cream freezer and, incidentally, to other household appliances, is shown in the accompanying illustration. This machine is being placed on the market by the Peerless Freezer Company, Winchendon, Mass., and can be utilized not only to freeze the cream, but to crush the ice and to operate washing machines, ironers and other household appliances as shown. The outfit is equipped with emery wheel for



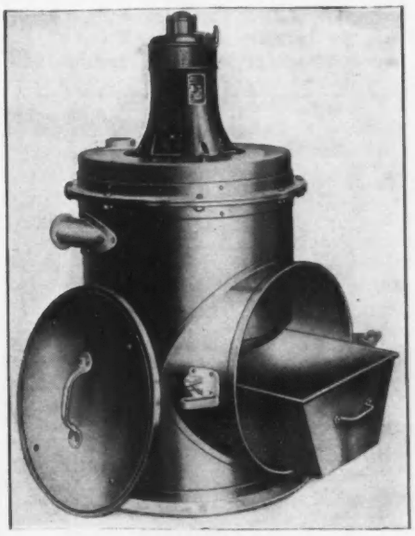
ADAPTING THE HOUSEHOLD MOTOR TO DRIVE WASHING MACHINE, ICE CREAM FREEZER, POLISHERS, ETC.

sharpening knives and tools and with brush and buffer for cleaning and polishing silverware. It may also be employed for cleaning and polishing shoes. The machine may well be termed a general utility motor on account of its all-around serviceability.

Stationary Vacuum Cleaner

To meet the demand for a vacuum cleaner for use in the home, that will suck all dirt, dust, germs and foul air out through a tube to a receiver in the basement, with no machinery or germ-laden exhaust air in the rooms, the Spencer Turbine Cleaner Company of Hartford, Conn., has developed the "steel turbine central home cleaner," as it is called. The system has the same characteristics as the large central cleaning plants frequently used in colleges, large office buildings, churches, hotels, department stores, and large residences and is designed to give the same kind of service in its field as the larger plant.

The plant is located in the basement, and a system of installing the tubing and wiring has been devised which will not cut up the house nor cause incon-



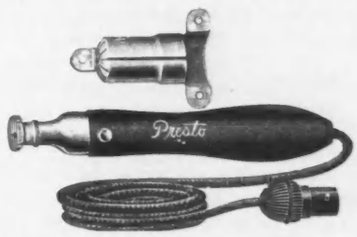
MOTOR-DRIVEN STATIONARY VACUUM CLEANING PLANT

venience. There is nothing to handle in the rooms except the cleaning tool and the hose, which is attached to an inlet valve, installed in the baseboard of the room. The apparatus is light and easy to handle. The advantages of this system are that all the dirt is sucked out through a tube, that no foul or exhaust air or any part of the dust is discharged back into the rooms, and that all the machinery is in the basement, where it is not moved or handled, and is not skimped in size or weight. It supplies a strong, even vacuum so well controlled as to avoid all possibility of injury to rugs or fabrics, it is claimed, and removes all dust and grit from cracks or pores in the floor.

The machine consists of a low-velocity wide-clearance Spencer turbine fan which produces the vacuum, a separator of the centrifugal type and a receiver of extra large size. The construction of the whole is of steel, welded and riveted. Bearings of large size are used. The illustration shows the station equipped with a 0.5-hp. "Universal" vertical motor manufactured by the Westinghouse Electric & Manufacturing Company of East Pittsburgh, Pa. The motor will operate successfully, within its capacity, and without the use of any external resistance on circuits of 140 volts direct current or alternating current of any frequency up to and including 60 cycles.

Electric Pipe and Cigar Lighter

In the accompanying illustration is shown an electrically operated pipe and cigar lighter adapted especially for use on automobiles. The device is provided

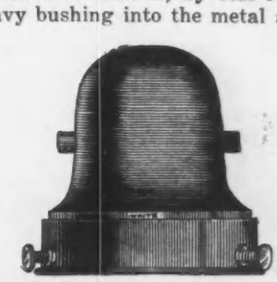


ELECTRIC CIGAR LIGHTER WITH HOLDER

with 10 ft. of cord so that it can be connected to the storage battery. By pressing a button the pipe or cigar can be lighted irrespective of the weather conditions or the speed at which the car is moving. A cord winder provided for use with the lighter may be fastened under the seat, at the side of the car, behind the dash, or in any other place where it is desired to put it. The cord winder automatically winds up the cord by spring tension and accordingly keeps the cord out of the way when not in use. The cigar and pipe lighter is being placed on the market by the Metal Specialties Manufacturing Company, 730 West Monroe Street, Chicago, Ill.

Socket Cover and Shade Holder

A fitting which is designed for use as a cover for push-button, pull-chain, key and keyless sockets and for use also as a shade holder, is shown in the accompanying illustration and has been developed by the J. H. White Manufacturing Company, 11 North Third Street, Brooklyn, N. Y. The screw bushing has been strengthened, the manufacturer asserts, by star-riveting a heavy bushing into the metal and by



SOCKET COVER WITH DEEP SKIRT

employing a heavier screw. The cover is provided with a deep skirt which permits the use of thick-lip glassware without showing a gap between the holder and the curve of the glassware. The cover also provides a clean-cut seat for cast and stamped crowns.

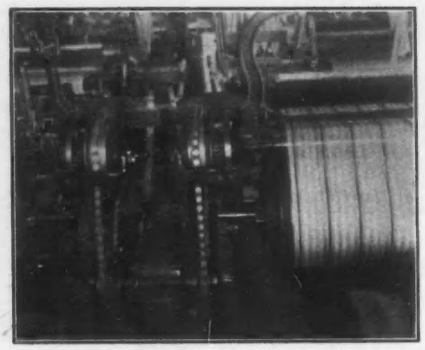


FIG. 1—TWO 40-IN. LOOMS DRIVEN BY 0.75-HP. MOTOR—VIEW FROM BACK ALLEY

Multiple-Drive Unit for Looms

A new method of driving looms in pairs from a single motor has recently been developed by the Graton & Knight Manufacturing Company of Worcester, Mass. The equipment is known as the multiple-drive unit, and in its design the effort was made to enable the textile mill owner to realize the flexibility and economy of belt connection, to obtain the benefit of reduced first cost in motor rating and to utilize his floor space efficiently in locating looms. The equipment consists of any standard motor for loom driving, mounted on a special bedplate and back geared to two V-pulleys carried on a shaft running on "SKF" ball bearings. From each pulley a V-belt of the Spartan block type or of the company's link type is run to the loom, the motor and its related equipment being mounted in the aisle between two adjacent looms. The starting switch is conveniently mounted on the frame of the multiple-drive unit. The V-pulleys are adjustable, one of each pair being rigidly mounted on the shaft and the other movable by locknut fastening. This enables the mill owner to obtain a finely-graded adjustment of speed through a 20 per cent range. The pulleys are designed with a 28-deg. groove. With the new unit one motor can drive two looms at different speeds at the same time. The housings on the ball bearings are large enough to require but one filling with grease yearly, so that the unit needs but minimum maintenance. With this equipment a 7.5-in. V-pulley can be belted to a 14-in. loom pulley, the belt center distance varying from 24 in. to 26 in., depending on the type of loom. The multiple-drive unit is made in ratings of from 0.5 hp. to 5 hp., inclusive, in 0.5-hp. steps. An instance of the power economy of the unit is shown in the fact that a pair of 88-in. tire-duct looms consume, when gear driven, 0.84 hp. each, whereas with the new drive a 1.25-hp. motor will run the pair.

Protective System for Service Apparatus

By inclosing in a sealable metallic cabinet such service equipment as watt-hour meters, cut-outs and switches, fire hazard and liability of injury to consumers are for the most part eliminated. Furthermore, all conductors or energy-carrying parts being under seal, it is impossible for mischievous persons to interfere with or interrupt the consumer's use of his service. It is also impossible inadvertently to tap a line on the service system ahead of the meter as all service work, together with

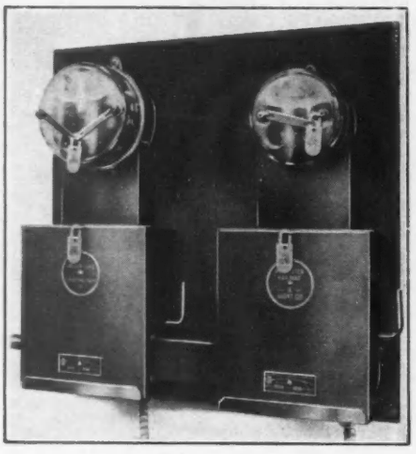
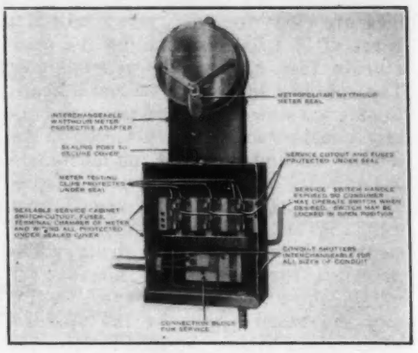


FIG. 1—TWO METERS WITH PROTECTIVE EQUIPMENT—CONDUIT CONNECTOR USED BETWEEN BOXES

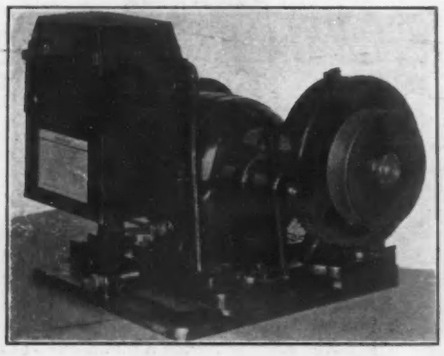
the meter wiring and terminals, is inclosed in metal and under the seal of the central station. Uniformity of installation, economy in wiring and facility in locating trouble also result from a standard service equipment. Tests on the meter can be made without disturbing any connections, simply by inserting a test plug into the contacts provided for them on the cutout; this results in a considerable saving of time on both alternating-current and direct-

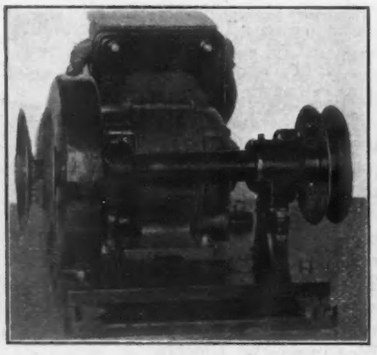


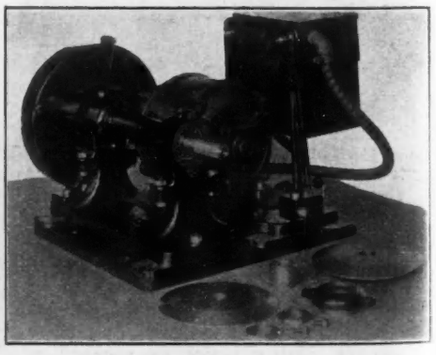
F.G. 2—DETAILED VIEW OF PROTECTIVE EQUIPMENT WITH COVER REMOVED

current, two-wire and three-wire lighting meters and simplifies the testing of polyphase meters as well as those operating on series and shunt transformers. It further insures against loose or reversed connections since it is unnecessary to disturb any of these connections to make the test. During the entire period of this test, the consumer may use his installation without a moment's interruption. Since it is unnecessary to disturb any connection while making tests, consequently there is no abnormal "stray-field" influence created by the connection around the meter.

In the accompanying illustrations are shown protective equipments developed by the Metropolitan Engineering Company, 35 Vestry Street, New York. The outfit consists essentially of a cabinet in which is located the service switch and service and meter testing cut-out, all under the seal of the central station company. The switch handle protrudes from the side of the cabinet and may be operated without disturbing the seal. This switch may also be locked by means of an inside latch in the "off" position when desired. The cabinet is equipped with openings for the different sizes of conduit or for open-wiring attachments. Provision is made at the end of the cabinet for protecting the terminals and wiring on any of the different types and makes of watt-hour meters. The system is so flexible and universal in its scope, the manufacturer points out, that it will accommodate any form of service equipment or watt-hour meter within the range of its ampere capacity. It is being made with standard ratings in accordance with the ruling of the Underwriters Laboratories, Inc., of the National Board of Fire Underwriters. The cut-out may be equipped with attach-







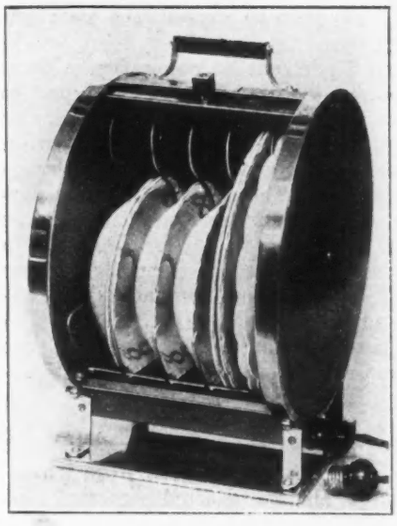
FIGS. 2, 3 AND 4—MULTIPLE-DRIVE UNIT FOR OPERATING LOOMS IN PAIRS BY A SINGLE MOTOR

ments for any one of the standard types of fuses, Edison screw base plug, National Electric Code standard or repulsion (link) types.

Where the use of energy has been temporarily discontinued and it is desired to remove the meter, this may be done and the service disconnected in the cabinet ready for instant reconnection when the occasion demands.

Electric Plate Warmer

A new application of electric service in the butler's pantry, kitchen and dining room is illustrated by a plate warmer which has just been placed on the

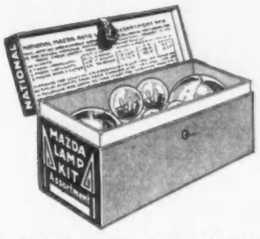


ELECTRIC PLATE-WARMING DEVICE

market by the Simplex Electric Heating Company of Cambridge, Mass. The apparatus is compact and light enough to be useful in the bungalow no less than in larger establishments and consists essentially of a nickel-plated Russia-iron cylindrical drum 12 in. in diameter, 9.5 in. wide and 17 in. high over the handle, with heating coils in the lower portion and equipped with a slide and plate rack holding ten plates. The latter rest on their edges and any one can be removed without disturbing the others. With an expenditure of from 250 watts to 300 watts the drum full of plates can be warmed in ten minutes and it will retain its heat about an hour after the energy supply is cut off, provided the drum is closed. The plate warmer can be connected to any lamp socket, and as it weighs but 10 lb. it can be utilized on the sideboard or even on the main dining table. The use of this equipment affords a decided contrast with the ordinary method of warming plates, in which the bottom of the pile is usually so hot as to preclude handling, while those at the top are still cold.

Automobile-Lamp Kit

An automobile-lamp kit in which the idea of proper lamp selection is incorporated has recently been brought out by the National Lamp Works of the General Electric Company, Cleveland, Ohio. The kit consists of a reinforced fiber-board case measuring approximately 2.5 in. by 3.5 in. by 6.5 in., fitted with a cloth-hinged top which when closed fastens by means of a leather snap lock. It holds six reserve lamps; the two end holders contain "headlight" lamps and the four center holders either "side light" lamps and rear and meter lamps, or two rear and two meter lamps, depending upon the car for which the kit is adapted. The kit has been tested in various ways and it is believed to be amply rugged in construction to withstand the hard usage to which a kit of this kind is certain to be subjected in the shop and on the road. From the engineering standpoint, the manufacturer claims, it is a step in the direction of insuring the proper lamp for the circuit. A thorough investigation of the lighting requirements of all makes of automobiles, it is pointed out, has made possible the selection of eight standard assortments of tungsten automobile lamps which are suited to 70 per cent of all cars. These eight assortments are numbered, the number appearing prominently on the lamp kit, and dealers are supplied with a key which shows the assortment number required by the various cars. Special kits adapted to the 30 per cent of machines which do not use one of the standard assortments are also available. In order to guard as far as possible against lamps being inserted promiscuously in the kits, and the purpose of providing proper lamps being



FIBER-BOARD CASE FOR AUTOMOBILE LAMPS

thus defeated, a list of the lamps which the kit originally contains is printed on the inside of the cover and shows what lamps are to be used in refilling the kit.

Improved Soldering Compound

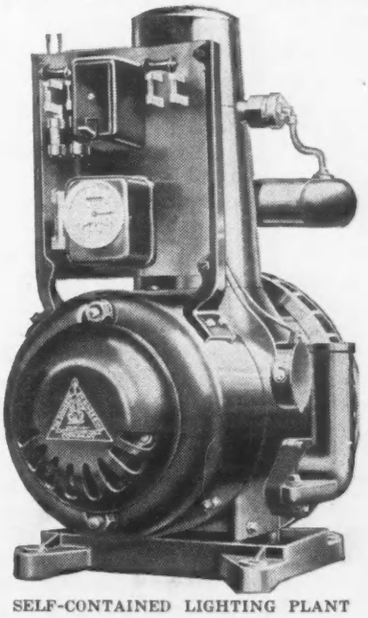
Hess & Son, of Philadelphia, Pa., have improved their "Tinol" soldering flux and the method of compounding it so that segregation, it is claimed, is now almost totally removed, and the material has the same consistency after a year of standing as it had when first made up. The actual percentage of flux in comparison with the soldering metal has been decreased, the manufacturer points out, while at the same time the fluxing power has been improved. This is due to an improvement in the character of the flux itself.

The older composition made it necessary for the workman to stir the paste thoroughly before using. This is now done away with, as the material is uniform and works evenly at all times without any stirring. The compound consists of finely granulated solder in various proportions of tin and lead, each grain of which is coated with a fatty organic substance which is neither acid nor alkaline. This coating of flux begins to melt before the solder, but is not completely evaporated until the solder has set; it thus protects the solder against oxidation during the entire operation.

Practice has shown that no special cleaning by scraping or dipping is necessary with such materials as tin, lead, brass, copper, etc., but iron and steel must be cleaned of rust and scale. It is easy to apply the compound and economical to use it since just the required amount can be applied to the joint, there being no dripping or other waste. "Tinol" also does away with the gummy, sticky residue which results from the use of rosin fluxes, the manufacturer claims, and in turn does away with the acid reaction which often occurs when solder and separate flux are used. The substance may be provided in wire form, containing as a core flux the paste as described above.

Gasoline Engine-Driven Lighting Outfit

In the accompanying illustration is shown a "Delco-Light" plant developed by the Dayton (Ohio) Engineering Laboratories Company and made and marketed by the Domestic Engineering Company of Dayton, a recently organized concern. The plant is a compact unit, consisting of a gasoline engine, dynamo and switchboard, and weighs about 325 lb. exclusive of the storage battery. The plant is set up ready for



SELF-CONTAINED LIGHTING PLANT

use when shipped. It is a 32-volt system and is rated at 750 watts. The outfit is especially well adapted for farm lighting and the manufacturer, the Domestic Engineering Company, claims it will light the average farm for less than 5 cents a day.

NEWS OF THE INDUSTRY

A Review of Activities in the Electrical Manufacturing, Selling and Central-Station Fields

Standards Adopted by Electric Power Club

Two Ratings for Open-Type, Continuous-Duty Motors Agreed On, Together with Terminal Markings for Generators and Transformers

The Electric Power Club held its annual meeting at Hot Springs, Va., from May 1 to 4 inclusive, with sixty-four delegates present, representing practically all the companies in the manufacture of electrical machinery, transformers and control apparatus. The meeting was very successful and a large number of recommendations were adopted tending towards the standardization of all classes of electrical apparatus.

Charles Robbins of the Westinghouse Electric & Manufacturing Company read a paper on "Temperature Ratings for Open-Type Motors Carrying Continuous Time Ratings." This question of rating has been before the Electric Power Club for some time, and a recommendation was adopted approving two ratings for open-type continuous-duty motors. The present Electric Power Club rating of 40 deg. C. rise at rated load and a 25 per cent two-hour overload guarantee as 55 deg. C. is retained, this rating to be known and designated as the 40 deg. rating, and a new Electric Power Club rating was adopted based on a 50 deg. C. temperature rise without overload guarantee, to be known and designated as the 50 deg. rating.

In order to distinguish properly between the two ratings, nameplates are to be marked with temperature and overload guarantees. The following descriptive statement of the two ratings was approved:

"Motors having the 40 deg. rating are designed for all classes of service, including those in which an overload capacity of 25 per cent for two hours is desired.

"Motors having the 50 deg. rating are designed for conditions in which the load requirements are accurately known and under which the motor will not be subjected to load in excess of the motor rating."

Considerable constructive work was done at this meeting towards the standardization of transformers and industrial control apparatus. These two new sections were added to the Electric Power Club at the last general meeting.

Standard sizes were adopted for mining locomotives, as also electrical performance guarantees, drawbar pull and the basis of motor rating. Standard voltages for mining locomotive motors were adopted as 125, 250 and 500 volts.

Specifications covering the capacity and voltage regulation of three-wire, direct-current generators were revised so as to make 10 per cent unbalancing in the neutral standard. Standard terminal markings for motors, generators and transformers were adopted, the transformer terminal markings to be subject to further conference with the National Electric Light Association. Standard general purpose alternators shall be designed so as to permit of operation at power factors at least as low as 0.80.

It is recommended that for geared service outboard bearings be used on motors in frame sizes above and including 75 hp. at 900 r.p.m., and for belted service in frame sizes 250 hp. at 600 r.p.m. and larger. Squirrel-cage elevator motors are to be rated primarily on the basis of guaranteed starting torque, and may also be given a horsepower rating based on the brake-horsepower which they will develop for the standard time rating selected without exceeding the standard temperature rise. Direct-current motors under normal operating conditions may vary not to exceed 7½ per cent above or below rated speed in sizes from 1 hp. to 7½ hp. at 1150 r.p.m. and 5 per cent in larger frame sizes.

Fractional horsepower motors must be designed to operate successfully with voltages 10 per cent above or below the rated voltage, but not necessarily within other limits established for normal operation. The allowable variation from rated speed under normal operating conditions for all sizes of fractional horsepower motors is fixed as not to exceed 7½ per cent. It is recognized as standard practice to furnish starting rheostats with shunt and compound-wound direct-current motors ½ hp. and larger.

E. R. Harding, vice-president of the Holtzer-Cabot Electric Company, was re-elected president of the Electric Power Club for the coming year.

Clarence L. Collins, president of the Reliance Electric & Engineering Company, Cleveland, Ohio, was elected vice-president, and C. H. Roth, president of Roth Brothers & Company, Chicago, Ill., was elected secretary and treasurer.

Factory Managers May Now Go to School

Industrial plant managers in all lines may attend school for two weeks during the summer session in scientific management at the Pennsylvania State College, State College, Pa. This is the second summer session of this school in charge of Hugo Diemer, professor of industrial engineering at the college. Mr. Diemer was formerly with the Tabor Manufacturing Company of Philadelphia. The course treats of factory management in industrial organizations, pointing out in particular the application of the Taylor system of scientific management. The course has been planned for two weeks, beginning Aug. 7 and ending Aug. 19, with registration day Aug. 5.

Fixture Manufacturers to Form Section of Associated Manufacturers

There will be a meeting of the manufacturers of electrical fixtures on May 25, at 2 p. m., at the Biltmore, New York, for the purpose of forming a section covering this particular line of industry in the Associated Manufacturers of Electrical Supplies.

This meeting has been called at the request of a number of manufacturers interested, who feel that an electrical fixture section will result in great good to the trade in general, and from the responses already received the meeting promises to be a representative one. It has been the aim of the general secretary, Charles E. Dustin, in issuing the invitations to include all manufacturers, whether members of the association or not, who are interested in this line.

Public Service Commission News

Missouri Commission

In the third annual report of the Public Service Commission for the year 1915 among other things is discussed the subject of "public relations." The commission says: "The public service companies operating in this State are fast learning of the common principle of doing business in the open and giving it the fullest possible publicity. Taking the public into their fullest possible confidence should be adopted by them as the wisest and the best policy. We believe that full and frank publicity should be the policy of every public service corporation with its patrons, to the end that all proper information to the investor and the public in general may be had. All public utilities are learning that the only way to gain the confidence of the public is first of all to merit it by square and frank dealing with the public. All public utilities should give full publicity to all dealings with the public; tell the public how much the company is earning, how it represents only a fair return on the value of the property devoted to the service of the public, and whenever there is a dispute over any matter of service dissolve the doubt in favor of the public, and do even more than is strictly required under its duties as a public service corporation.

"We believe the public is now becoming ready to meet the public service corporations at the half-way station with fair, just treatment. If the integrity of investment vital alike to rich and poor, employer and employee is to be properly maintained, such should be the attitude of the public toward such public service company."

There are many items in the operation of gas, electric and water plants in Missouri which, in the opinion of the commission, undoubtedly require regulation if for no other reason than to induce uniformity. One subject that the commission believes should have early attention is the issuing of uniform service extension rules. In regard to this matter the commission states in its annual report:

"As the matter now stands, each company or municipality makes and enforces its own rules regarding changes for extending main or service pipes for water or gas, or line extension and service wires to houses. The result is that there are almost as many policies followed as there are companies and municipalities operating these plants. These companies often depart from any fixed policy in their effort to get customers, with the result that there is often discrimination in appearance if not in fact. Fairness to the consumer also demands that this matter be adjusted. The extension rules of some companies seem to be designed along some reasonable or well-defined business policy, while others hold the policy of taking on only customers immediately profitable. No doubt the interest of the whole body of consumers demands that the investments be not made lavishly. On the other hand, anyone reasonably situated should not be denied those things which have come to be regarded as necessities. The most reasonable rule to follow appears to be one that would reject or assess a charge against only those consumers the serving of whom would entail a higher rate to the whole body of consumers."

Illinois Commission

A preliminary set of rules and regulations governing overhead electric construction is being distributed by the State Public Utilities Commission to the electric and telephone utilities and common carriers of Illinois. The regulations are the most comprehensive yet to be issued by the commission, embracing (1) inductive disturbance of telephone lines by transmission lines, (2) joint construction, (3) crossings between wires, (4) crossings of railroad tracks, and (5) general overhead construction. The proposed rules, which are to supersede the commission's existing rules, are classified carefully into approximately 100 sections and contain some 12,000 words. The engineering staff of the Illinois commission, in these rules, has given the most careful consideration to the types of overhead construction, over which the commission possesses explicit jurisdiction and exercises power to regulate. The rules are not intended to be an elaborate exposition of theoretical and technical design but instead are concise statements in simple language of the requirements which will later be exacted, not only of the large electric utilities with their skilled organizations, but also of the smaller utilities of the State. In only a few provisions, where some mild technical description apparently is unavoidable, do the rules trespass into an involved theoretical field. Safety first has been paramount, and adjustment of inter-corporate friction occasioned by inductive disturbances and by joint construction are advocated. The utilities of the State will be given ample opportunity to be heard in conference at Springfield on May 16 and 17.

As the transmission lines of the various electric utilities spread more and more over the less densely populated territory of the State, the Illinois commission has been confronted with the question of what service a rural consumer is entitled to. Naturally enough, the usual position of an electric utility is to supply such farmers as may be connected to its system with profit, and it is necessarily the duty of the commission to prescribe that rural service shall be rendered without unfair discrimination, on equal terms, to all applicants.

For certain purposes, electric consumers may be classified as urban, suburban and rural. The relative status of these classifications, with respect to line extensions and service connection, is discussed for the first time by this commission in two recent orders—Abbott Light & Power Company versus Andrew Parks, and in re application of Abbott Light & Power Company for approval of rate and rule for rural consumers.

For urban consumers, the published rules of the commission provide that a utility, which serves a municipality shall extend its overhead mains two standard pole lengths for each new consumer, with payment by the consumer for any excess over two poles. In other words, if a group of six new houses, located within corporate limits, say 1800 ft., or eighteen pole lengths, away from the existing terminal of a utility's electric line, the company, upon application of the six householders for electric service, would be required to install at its own cost 1200 ft. of this pole-line extension, and would be permitted to bill the proposed consumers for the cost of the 600 ft. excess above the requirements of the commission's rules, provided that refund is made to the six consumers whenever other new consumers, from time to time, may be added to the original 1800 ft.

Rural consumers, who may be located within possibly a mile of an inter-city electric transmission line, may often be safely served by the utility operating the transmission line. To serve such a consumer, however, it is usually necessary to install two sets of pole-line transformers, a set of lightning arrestors, a service line of varying length, and the customary meter and service box. Obviously, the investment required for a rural consumer is considerably more than for an urban consumer. The most troublesome feature to take care of without discrimination is the service line, which may vary from a few feet for one consumer to a mile or more for another consumer. The commission is taking the position that the regular devices (transformers, lightning arrestors, meters, etc.) are to be installed by the utility. The greater investment in equipment to sup-

ply the rural consumer, over the urban consumer, is to be compensated for by a somewhat greater minimum bill which the rural consumer must agree to pay. As to the service line, the commission takes the position that two pole lengths are to be installed at the cost of the utility, the same as in urban extensions, and that the remainder of the line is to be installed at the cost of the rural consumer. All maintenance is to be performed by the utility, and its cost is properly compensated in a proper minimum monthly bill.

The suburban consumers, *i.e.*, residents in the environs of a municipality, possibly not far from a utility's local distribution, are somewhat special and must be treated individually. Probably the majority of the suburban consumers would be served from the local distribution system in a manner quite similar to urban consumers. Other possible consumers, who may happen to reside somewhat too far from a municipality to render it practicable to extend the low-voltage distribution system, may be fortunate enough to be within workable distance of some transmission line from which it may be feasible to procure electric service. The location of a suburban consumer, unfortunately, has much to do with the conditions under which he may secure service.

Inasmuch as the commission, in its opinions and orders respecting the issuance of securities, as a rule has entered into little discussion of the underlying reasons for its findings, the public utilities of the State may be interested in certain pertinent information regarding the commission's attitude to utility capitalization in a decision rendered in re Southern Illinois Gas Company, together with a dissenting opinion therein by Commissioner Shaw. The commissioner discusses at length several debatable subjects, such as (1) interest during construction and development, (2) engineering fees, (3) legal and organization expenses, (4) expenses of promotion, (5) total overhead expenses, (6) working capital, (7) discount on bonds, (8) stock bonus, (9) commission supervision over issues of securities, and (10) inducing capital to invest in public utilities, and in connection with the commission supervision over issues of securities, states:

"It may be contended that, under the act creating the State Public Utilities Commission of Illinois, any value determined upon for the purpose of the approval of the issue of stocks and bonds for capitalization will not represent necessarily a reasonable value of the property for purposes of rate-making. It is my opinion that, under the law, the total par value of the securities should not be materially greater than the total value of the plant as a going concern. It already has developed in rate-making cases before this commission that, if the outstanding stock and bond issue exceeds the total value of the property as a going concern, great pressure and stress are brought to bear on the commission at hearings of the cases, on the part of the utilities seeking pretexts for the commission to find values equal at least to the outstanding securities. It usually is claimed that a reasonable supposition is that the par value of the outstanding securities represents the total investment in the plant to date, and that these securities should be protected by the commission by finding the par value of the securities to be the proper value upon which to base fair and equitable rates. The claim is made further that, if the commission finds a value lower than par of the securities, the utilities will be unable to finance future securities in the market whenever additional funds must be raised for the making of betterments, additions, extensions and improvements to the existing properties.

"In the case at bar, the petitioner virtually asks that the commission's finding of the value of the gas property when constructed be equal to more than twice its estimated cost. This fictitious value the petitioner desires permission to capitalize solely on the grounds that probable (by no means certain) future earnings will be of ample magnitude to pay interest on the bonds and dividends on the stock. Such being the case, the petitioner trusts that the stocks and bonds, which may be authorized by this commission to be issued, may in the future have a market value equal to par. This theory of business promotion, in sundry variations, has been at the root of nearly every famous exposure of stock watering. Past misuse of public confidence is fundamentally the cause of legislative action creating federal and State regulatory bodies.

"To use other words, it is the desire of the petitioner herein that, whatever amount of stocks and bonds may be authorized, the amount so authorized shall be taken as the value of the plant after it shall have been constructed and in successful operation. This aspect of the situation, from my point of view, is dangerous in that this commission, in a future rate case, undoubtedly would have to take some judicial notice of past findings of utility valuation made for purposes of issuing securities. I am inclined to the opinion that a value found for one purpose (security issues, for instance) should not be essentially irreconcilable to a value found for another purpose (*i.e.*, rate-making).

"This commission, acting under the present law in the case at bar, I believe, necessarily must consider the protection of the public in making investments, the rates to be paid by the public, and the sale of the service to the public. The commission cannot escape taking cognizance of the effects and results of approving what in my opinion is an overcapitalization of the new project."

Approval has been given by the commission of the Western United Gas & Electric Company to initiate a continuous meter-reading system, whereby the territory of the company is divided into districts in which meters are to be read and bills rendered at monthly intervals that are not coincident in any two districts of a city. Such a system enables the meter-reading and billing force to work continuously throughout the month at an excellent load factor, instead of concentrating their work into a few days toward the end of a month. Outside of Chicago the Western United is the first Illinois utility to apply for approval of the continuous meter-reading system. The commission's finding is: "It appears that the scheme of 'continuous meter-reading' proposed by the petitioner is reasonable, and will result very probably in an efficient, economical and correct utilization of the petitioner's organization of meter readers and billing clerks."

The rules and regulations which were permitted by the commission to be placed in effect are as follows:

"1. The city, town, village or unincorporated territory will be divided into suitable sections and the discount period for the several sections will be fixed by the company, such period to terminate fifteen days after the date upon which bills are rendered for the amount of gas, electricity or steam consumed during the period of one month preceding the date of the reading of meters in the said section.

"2. Notice of the termination of the discount period shall be printed on each statement rendered to consumers, and the discount period shall not be changed after it be once established, without additional and reasonable notice to the consumer.

"3. Any one consumer who may pay bills in two or more districts as established by the company, may arrange with the company for the payment of such bills at one time so that the discount period of all such bills shall expire at the same time.

"4. All other regulations of the company, with respect to discount periods heretofore adopted except in so far as the same are hereby changed, shall continue in effect until further notice."

Three-Quarters of Missouri Meter Utilities Furnish Electric Service.—Of the 420 public utilities in Missouri furnishing electric, gas, water and heating service, 305 furnish electric service, 149 water service, forty-three gas service and eleven heating service.

New Orleans Has Successful Electric Show.—The first New Orleans electric show was held during the week ended April 29 under the auspices of the local Jovian League. The attendance was 10,000. There were twenty-eight exhibitors representing almost every branch of the electrical industry.

Oregon Municipal Plant Furnishes Free Energy for Porch Lights.—The City Council of Ashland, Ore., is offering free electric energy for porch lamps to every resident user in the city, and, according to reports, a big majority of the customers of the Ashland municipal plant are installing porch lamps.

Maine Utilities Honestly Conducted.—In the first annual report to the Governor the Maine Public Utilities Commission says: "The great majority of our utilities have been honestly conducted. Mistakes have been made, but honest ones. Errors of judgment have sometimes been expensive, but only very little evidence of actual fraud has been discovered."

Dye Shortage Felt in Telephone Industry.—The shortage of dyes, which in ordinary times comes from Germany, affects the telephone business to some extent. The pair of jumper wires used on the main frame formerly consisted of one white and one red cord; but from now on they will consist of one white cord and one white cord with a couple of red threads in it.

Old Oil and Gas Fixtures Wired for Electricity.—A Canadian firm of electrical contractors and dealers is making a practice of attending all nearby auctions and buying antique oil and gas-lighting fixtures. These, which command but a small price at the auction, are wired for electricity and refinished, with the result that as a rule, owing to their being antiques, they bring far greater prices than brand-new ware.

Ohio State University's Third Electrical Show.—The third electrical show given in Robinson laboratory, Ohio State University, Columbus, by the electrical engineering students, began on April 27 and continued three days. The local branch of the American Institute of Electrical Engineers financed the show for the students in order to awaken a wider interest in the work. An admission of 25 cents was charged to cover the expenses of staging the show. Many interesting experiments calculated to mystify the visitors were shown. Several prominent manufacturing firms made exhibits. Some of the displays were as follows: Automatic Reclosing Circuit Breaker Company, models of circuit breakers; Honeywell Heating Company, thermostats for regulating furnaces; Central Union Telephone Company, telephone apparatus; Ohio State Telephone Company, telephone apparatus; Johns-Manville Company, fire extinguishers.

Current News and Notes

Timely items on electrical happenings throughout the world, together with brief notes of general interest.

Flour Mill Contracts for 4600 Hp.—The Minneapolis division of the Northern States Power Company has signed a contract with the Washburn-Crosby Milling Company calling for the delivery of 4600 hp. of electrical energy to the Minneapolis flour mills. The contract is for a period of fifteen years and largely increases the quantity of electrical power heretofore supplied the mills by the power company.

Hydroelectric Development of Spain.—There are in Spain 110 hydroelectric developments, according to statistics published in the *Union Electrica*. Of these fifty have a rating of more than 800 hp. with a combined rating of 1,008,876 hp., of which 266,576 hp. is in the process of development. Twenty-one installations range from 300 to 700 hp. with an aggregate rating of 10,243 hp. The remaining thirty-nine plants are rated at less than 300 hp. each.

Illinois Commission to Print Orders Weekly.—In answer to insistent demands from interested utilities, attorneys and others, the Illinois commission has made definite arrangements to print all its orders once a week in pamphlet form, commencing May 1, 1916. The orders of the commission at the present time are aggregating forty-eight to sixty-four pages of printed matter per week. For the next four months the pamphlets will be mailed regularly on trial, without cost, to those applying of the secretary. Subsequently, if the mailing list assumes unduly large proportons, a nominal subscription price may be charged by the commission.

Technical Report Writing Required at Stevens Institute.—A year ago the faculty of Stevens Institute of Technology planned for the introduction of report writing as a requirement for graduation. One afternoon per week during the second half of the senior year is given to this work. The present senior class is the first to complete this work. Data for these reports are obtained mostly by a search of the literature of the subject, while experimental work is neither required nor encouraged. The subject of the report is chosen by the senior himself during his first term, and is submitted for approval to the head of the department in which it falls. The students are prepared to take up this report writing by exercises or "themes" which have been introduced into the junior year. Reports which have just been submitted by the present seniors not only cover branches of mechanical, civil and electrical engineering, but also chemistry, physics, economics and welfare work in industrial organizations.

Oregon Town Defeats Municipal Ownership.—The town of Silverton, Ore., now served by the lines of the Portland Railway, Light & Power Company, decisively defeated a proposition for a municipal electric light plant on May 1 by a vote of 288 to 47.

Accident Hazard of Electricity in Metal Mines.—Out of a total of 366 persons killed underground in metal and miscellaneous mineral mines (coal excepted) during 1914 but eight were killed by electricity, according to the report by the Bureau of Mines. This is at the rate of 0.08 deaths per 1000 persons employed underground. Five out of a total of 3766 were seriously injured by electricity or 0.05 per 1000 employed underground, while in forty-seven cases, or 0.47 per 1000 employed, out of a total of 19,531 slightly injured, electricity was the cause.

Government Regulation of Electric Rates in Chile.—All electric companies in Chile, furnishing light, power, telephone or transportation service, must submit their rates for the approval of the President, unless such rates have been established by law or concession. When rates have been fixed, they cannot be altered without the approval of the President, and failure to comply with these regulations will result in cancellation of contract. No concession will be granted or renewed unless the concessionary agrees to give a discount of 50 per cent from regular rates to public or municipal offices of the cities in which the service is supplied.

Company Formed to Supply Stockyards with Light.—The Illinois Public Utilities Commission has granted to the Produce Terminal Company a certificate of convenience and necessity to transact a general electric business in a limited area within the city of Chicago, known as the "stockyards area." It appears from the record that the Commonwealth Edison Company, which now enjoys a monopoly of the electric supply business in the greater part of Chicago, was not providing energy to the stockyard district. The Produce Terminal Company is organized to take over an existing plant and distribution system of a former stockyard plant, and is authorized to issue stock in the amount of $180,000.

Special Practical Engineering Courses for Electrical Engineering Students at University of Minnesota.—Three courses of special value to the electrical engineering student are being offered at the University of Minnesota by recognized experts in their lines. Charles L. Pillsbury, who has recently completed extensive valuation work in Detroit, Washington and elsewhere, is delivering a course of eighteen lectures on "The Valuation of Electrical Properties" for the fifth-year students. R. A. Lundquist, consulting electrical engineer, is giving a course of lectures to the fifth-year students on "Transmission Line Construction." Fred Dustin, treasurer of the Standard Electric Company of Minneapolis, is giving a course of lectures to the sophomores and juniors on the "Practical Applications of the National Electrical Code."

New York Jovian League.—Inspector Joseph Faurot, in charge of the detectives of the New York Police Department, spoke at the regular meeting of the Jovian League of New York City on May 10. A very successful rejuvenation was held on May 12.

Los Angeles Jovian League.—Dr. Arthur S. King, superintendent of the physical laboratory of the Mount Wilson Solar Observatory, on May 3, spoke before the Jovian Electric League on the subject "The Equipment and Method of Work at the Mount Wilson Solar Observatory."

Jovian Chapter, Cleveland Electrical League.—A special meeting of the Jovian Chapter of the Electrical League of Cleveland was held at Case School on May 2 to examine the school's laboratory under the direction of Prof. Henry B. Dates. A demonstration and exhibition of high-tension apparatus, photometric phenomena, arc welding process and a complete wireless plant were given.

Pittsburgh Section, I. E. S.—The May meeting of the Pittsburgh section of the Illuminating Engineering Society was held at the "Hofbrau," Cleveland, Ohio, on May 12. W. R. Mott presented a paper on "White Light for Moving Picture Photography," being an illustrated report of an exhaustive study of the application of the white flame carbon arc for this work. W. E. Brewster introduced a discussion on the subject "The Photography of Lighting Installations."

Seattle Section I. R. E.—The members of the Institute of Radio Engineers and their friends now at Seattle, Wash., were recently tendered a dinner by the Seattle section of the Institute. The guests were Judge Jere Neterer, L. F. H. Betts, Lieut. E. J. Blankenship, D. N. Cosgrove, Philip Farnsworth, A. H. Ginman, V. Ford Greaves, Frederick A. Kolster, Dr. Carl E. Magnusson, Dr. Frederick Osborne, Greenleaf W. Pickard, Frank N. Waterman, Roy A. Weagant.

San Francisco Section A. I. E. E.—A joint meeting on military preparedness, invitations to which were sent to all San Francisco members of the American Institute of Electrical Engineers, the American Society of Civil Engineers, the American Society of Mechanical Engineers, the American Institute of Mining Engineers and the American Chemical Society, was held in that city on May 2. The speakers on the program were Capt. Richard Park, Engineer Corp, U. S. A., Capt. John Murphy, Coast Artillery, U. S. A., and A. H. Babcock, member Naval Consulting Board. After a discussion of the various means by which the engineer can effectively prepare himself for service in war times, a resolution was adopted requesting the local officers of each of the five societies to appoint a committee of three who would constitute a permanent central committee to facilitate co-operation among engineers in military preparedness matters, and to represent the engineering profession in military matters in the State of California.

Associations and Societies

A complete Directory of Electrical Associations is regularly printed in the first issue of each month on the next-to-last text page.

Chicago Section, A. S. M. E.—Joseph Harrington, advisory combustion engineer, Chicago, Ill., will present a paper on "The Use of Powdered Coal as a Fuel" before a meeting of the Chicago section of the American Society of Mechanical Engineers which is to be held on May 15.

Franklin Institute.—Demonstrations of transcontinental and wireless telephony will be made in the hall of the Franklin Institute during the afternoon and evening of May 17. Previous to the demonstrations there will be a stated meeting at which the following program will be followed: Presentation of the Franklin medal to Theodore William Richards, director Wolcott Gibbs Memorial Laboratory, Harvard University; presentation of the Franklin medal to John J. Carty, chief engineer, American Telephone & Telegraph Company; presentation of the Elliott Cresson medal to the American Telephone & Telegraph Company, Theodore N. Vail, president. The following addresses will be made: "The Fundamental Properties of the Elements," by Theodore William Richards; "The Telephone Art," by John J. Carty, and one by Theodore N. Vail.

Empire State Gas and Electric Association.—The mid-year meeting of the Empire State Gas and Electric Association was held at the Iroquois Hotel, Buffalo, N. Y., on May 4 and 5. The first day was devoted to the discussion of committee reports and to matters dealing with public relations. The public relations topic was subdivided along the following lines: Physical arrangement of offices; personal work by officers and employees; giving out news stories to newspapers; campaign through advertising columns of the newspapers; the use of charts and graphic representation of business data for publicity purposes; bulletins and circulars. For the second day the program was in charge of the commercial committee and included discussion of the following topics: "Department Store and Hotel Electric Business," "Prepayment Meter—Its Advantages and Disadvantages," "The Domestic Consumer—Methods of Developing This Business," and "Marketing Coke." An opportunity was afforded to members to visit and inspect the Robertson Cataract Electric Company's new building. The meeting of the electric meter committee, on April 14, was held in Ithaca, where the electrical laboratories and various other departments of Cornell University were inspected. At the meeting which followed at the offices of the Ithaca Electric Light & Gas Company there was a discussion on the topic "Methods of Installing Electric Meters."

The Radio Club of America.—The next meeting of the club will be held on May 12, at Columbia University, New York City. Dr. John Stone Stone will lecture on "Fundamental Considerations in Oscillating and Resonance Circuits," with a prefatory remark on the necessity of amending the restrictive wave length regulations now in force.

West Virginia Public Utilities Association.—The executive committee of the Public Utilities Association of West Virginia met at Charleston on May 8 and arranged a program for the regular annual meeting of the association to be held at Parkersburg on July 13-15. The committee is composed of W. C. Davisson, vice-president and treasurer of the West Virginia Water & Light Company; Herbert Markle, general manager of the Appalachian Power Company; M. A. Maxwell, manager of the Logan County Light & Power Company; P. P. Crafts of the Parkersburg Light & Power Company; E. W. Alexander, secretary and general manager of the Charleston-Dunbar Traction Company; W. R. Power, superintendent of lighting of the Consolidated Heat, Light & Power Company, and R. A. Schott, sales manager of the Virginian Power Company. Details of the program of the forthcoming meeting will be given out later on.

Central Division, Supply Jobbers.—Sessions of the Central Division of the Electrical Supply Jobbers Association were held at Excelsior Springs, Mo., on April 20 and 21. There were business meetings morning and afternoon of Thursday, and Friday morning; Friday afternoon was devoted largely to golf. the practical matters having been concluded. A. J. Selzer, chairman of the division, presided at all sessions, and Franklin Overbagh, secretary of the national association, who ararnged the program, acted as secretary. The subject "Selling Policy" was discussed by N. G. Harvey, who displayed a chart of prices of materials, indicating increases; and by F. M. Bernardin, who read a carefully prepared paper giving comparisons in the advances in the costs of materials. During the discussion, it was pointed out that some jobbers and retailers are not selling at the market, but are letting goods go at prices on such levels that the goods cannot be replaced at a profit. W. W. Low and H. P. Andrae talked on specific shortages of supplies and increase in cost of various materials, under the subject "Supply—How It Affects a Selling Policy." H. L. Grant discussed the matter of co-operation among jobbers, and between the jobbers and retailers, to maintain a market situation that would prevent serious embarrassment to the trade as prices of materials continue to advance. S. E. Kennedy discussed "The Abuse of the Cash Discount," showing wherein the imposition on the jobber and manufacturer by firms extending their credit arbitrarily reacted to the detriment of the trade in general. The general discussion following the set program indicated that there is much confidence in the actual values of materials and commodities as now established, and in business conditions.

FINANCE, COMMERCE AND INDUSTRY

News of the Trade for the Manufacturer, Wholesaler and Jobber of Electrical Equipment and Supplies—Notes on Industrial Activities and Business Methods

Plug and Receptacle Buying Large

Manufacturers Have Difficulty in Taking Care of Volume of Business Owing to Its Size and to Slow Deliveries of Raw Materials

Trade in plugs and receptacles reflects the general prosperity that is evident in the electrical industry. For the first quarter of this year the volume of orders in some shops was fully equal to the entire bookings for the previous twelve months. How much of this is finding its way immediately to the ultimate consumer or is due to a demand on the part of the ultimate consumer is not known.

Much of this business is jobbed and the orders for the past few months show jobbing houses ordering in large quantities. There is, of course, a good retail trade in this line. New construction is increasing rapidly and in large volume and electric wiring of old houses is receiving the active attention of both the central station and the electrical contractor, but this market was not opened up with a jump, as the bulk sales of plugs and receptacles would at first glance seem to indicate. The only conclusion that is left is that supplies ran low and jobbers in anticipation of an appreciable advance in prices not only completed their stocks but heavily overstocked. The volume of buying, it is expected from present indications, will keep up for some months.

Prices have advanced in some cases 50 per cent and further advances can be expected if production costs continue to rise as they have. To a certain extent, of course, quantity production has cut the production expenses down appreciably, but in view of enormous increases in certain individual costs quantity production was not able to prevent advanced prices. Copper and brass have more than doubled in price and wages have gone up. All of the other raw materials cost more than they did a few months ago.

There is one very serious situation that has recently been eased up somewhat and that is the deliveries on raw materials. For a while this was further aggravated by the freight congestion, but this difficulty is now being well managed. Brass and copper are very hard to obtain, especially brass. The brass industry is simply swamped with business and cannot promise any kind of a decent delivery. For this reason delivery of the finished product has been somewhat delayed, although deliveries are now much better than they were a couple of months ago. Also the large amount of buying is lengthening out the promised deliveries.

The credit situation is good, but extreme care is being exercised in regard to those buyers who it is thought are stocking up beyond their needs. Collections are good and in fact are better than they have been for many months. At the same time the large recent purchasing has caused collections to slow up somewhat.

Copper Going Higher

The month of May opened with a large demand from Europe, and a firm demand for domestic consumption. Prices for immediate delivery opened up at a shade less than during the latter part of April, owing to sales by those who had previously overstocked at lower prices and who are now taking advantage of the market to make a profit. These sellers are covering their present sales with future orders at a less price. It is not, however, to be expected that prices will take any very appreciable drop, especially as the war consumption is not falling off and Europe is still in the market for large quantities of copper. Indeed, in some quarters the belief exists that if anything copper will go much higher before it goes lower to any great amount. Fluctuations are bound to occur, but the general tendency is expected to be higher. In fact, indications now point to 40-cent copper before the market comes back to normal.

Electrolytic was nominally quoted at 30 to 31 cents per pound for prompt and May delivery, which is 3 cents higher than it was a month ago and 13 cents higher than a year ago. For June delivery the nominal quotation was 29.5 to 30 cents, July and August a half a cent less and for the last quarter of the year from 28 to 28.5 cents.

These prices did not stay, however, and were only nominal. Sales have been reported at 31¼ cents for immediate delivery, with 32 cents asked. For June deliveries 31 cents has been asked and for July 30½ cents.

Further advances have been made for September and October deliveries, numerous sales having been made at 29¼ cents for the former and 29 cents for the latter. November and December deliveries have advanced to 29 cents. Sales have been made through the middle of 1917 at 28 cents.

The spot market is about sold out and with a large number of inquiries for promut shipment it is expected that even greater premiums will result.

During April the sales of copper were very large, but the inquiries for the first few days of May did not show that all needs were supplied. It has been estimated that already over 75 per cent of the estimated possible 1916 production was contracted for, so that the American producers will hardly be in a position to handle any further very large amounts of the red metal.

In regard to the situation in the market for copper on April 20 the National Conduit & Cable Company says:

"The situation obviously leads to the conclusion that the demand for copper may be expected to keep up at an impressive rate all this year. Prospective consumptive requirements will undoubtedly remain above normal, but it is of importance to have evidence that production has also risen to tremendous dimensions.

"Recent developments in the copper situation reveal the eagerness of buyers to purchase the metal on the biggest scale ever known in the history of the industry. Despite the high market level now ruling it has not proved any barrier to the most vigorous demand on record. Purchases by the British and French governments this month of huge quantities of American copper were notable features which furnished the stimulus to another new upward movement of values.

"The extraordinary character and extent of the recent business in copper have supplied the best possible basis for the present phenomenal strength of the market. The remarkable expansion in demand indicates an absorptive capacity greatly exceeding anything ever recorded before. Consumption of copper in 1915, and thus far in 1916, is the greatest ever reported. The tonnage of copper going into the melting pot is a true index of the urgency of requirements. If the present rate of domestic consumption is maintained until the end of the current year the aggregate quantity of copper consumed in the United States during 1916 may reach the stupendous total of from 1,200,000,000 lb. to 1,500,000,000 lb.

"Notwithstanding the possibility of an international crisis at an early date the copper market remains decidedly firm. Continued purchases of late deliveries at advancing values is accepted as the best illustration of the underlying strength and statistical soundness of the market. The dominant influence is the huge demand and the steady volume needed for actual consumption. There appears to be a scarcity of April and May metal, but consumers' requirements are well covered for these months. Productive capacity will undoubtedly be kept working to limit of ability to meet the exigencies of an abnormal situation. It is, therefore, quite certain manufacturers will not lack for supplies unless demand runs ahead of the present rate."

Strengthening American Business

Vice-Chairman E. N. Hurley of the Federal Trade Commission has made the following statement regarding aids to obtaining credit, the stabilizing of accounting systems, and the importance of a knowledge of true costs, setting forth how the commission can be of constructive help to American business:

"The small manufacturer, the country storekeeper, and the retail merchant often do not get at the banks the credit that they ought to receive, owing to the fact that they are unable to present balance sheets in accordance with good business practice. These men as a rule are just as good business men, in many respects, as those of larger operations. They have brains, ability and knowledge of their wares and of their customers, but they do not speak the language of the banker in that they are not able to present a statement showing their true assets and liabilities.

"Frequently a business man with a credit of a few hundred dollars at his bank, based wholly on personal grounds, could, if he could produce a reliable balance sheet, steadily obtain sufficient credit to enable him to rapidly expand his business along sound lines. Failing to obtain such credit, his business is limited and confined.

"Ability to borrow at the bank has a far-reaching effect on all credit, because to the bank, primarily, are directed inquiries for a rating of a manufacturer or merchant seeking credit for goods. An unfavorable or noncommittal report from the bank results in a curtailment of opportunity.

"Bankers are in business to loan money to business men, and recognize that loans made on balance sheets that show a healthy condition are desirable loans. The banker will welcome any standard form of statement that will permit him easily to ascertain the exact liabilities and assets of his customer.

"It is recognized that no one standard system of accounting is applicable to all classes of business, but that special systems are required for each group or class of commerce and industry. For example, the coal industry can use a substantial standard system of accounting; similarly, the country store and general store retailer, the wholesale grocer, the retail grocer, the boot and shoe wholesaler, the boot and shoe retailer, the drug store, the manufacturer of textiles, the manufacturer of machinery, the wholesale clothier, the retail clothier. It is true that a great many systems could be adapted for use in lines other than those for which they are originally arranged, as certain fundamental principles underlie the general structure of accountancy which must be recognized by each group.

"The commission, however, while recognizing the commercial advantages to be derived from uniformity of systems, does not advise making a change where systems already installed give adequate information and are economically operated.

"The fact must be admitted that in order to put a selling price on a product a manufacturer must first know what it costs to manufacture and to sell it. When business was done on a large percentage of profit this was not so essential, but in most lines of industry to-day the large percentage of profit has passed. Manufacturers are working on smaller margins and must absolutely know what their goods cost. Any unreliable method of arriving at cost figures, with margins of profit so close, must be eliminated.

"It is a fact well understood among business men that the general demoralization in a large number of industries has been caused by firms who cut prices not knowing what their goods actually cost to manufacture, and the cost of selling, which is equally important, is almost wholly lost sight of.

"A manufacturer who does not know with a close degree of accuracy what it costs him to produce the different articles he manufactures and what it costs him to sell them, is not in a position to intelligently meet competition and invites business disaster.

"Many of the larger manufacturers have thorough cost accounting systems, which they recognize as necessary in order to give them the information essential to successful management. On the other hand, the number of smaller manufacturers who have no adequate cost accounting system and who price their goods arbitrarily is amazing.

"Proper accounting for the smaller manufacturer is most essential. It is necessary for his success that he know on what particular article he is making a fair profit and on what he is making only a narrow margin of profit or losing money. If he has this information he can concentrate on the manufacture and sale of the product on which the profits are satisfactory.

"Whole industries, in many instances, are suffering from a general lack of intelligent knowledge of cost."

Labor Somewhat Quieter

In general the labor unrest that has been prevalent in this country for some weeks was somewhat abated this past week. A number of shops that have been closed again opened and the men returned to work without violence or hindrance.

In the Pittsburgh district the Westinghouse interests again started up. The Union Switch & Signal and the Westinghouse Airbrake operators were all at work early in the week and resumed operations. By Thursday the Shadyside plant of the Electric & Manufacturing Company, where automobile equipment is made, was again in full swing.

About one-half of the men at the Westinghouse Electric & Manufacturing shops and the Westinghouse Machine shops went back to work on Tuesday following an announcement of President Herr that unless the men returned at once they would lose all pension and bonus benefits that they enjoyed previous to the strike.

The men went out on April 21, and while they made no formal demands on the company, it was generally understood that an eight-hour day was wanted at the same daily wages for the longer day. The strikers will not receive either the eight-hour day or a raise in pay.

It is expected that all of the Pittsburgh plants will be in full operation by the beginning of the week.

Electric Range Idea Growing

With great rapidity is the effort to permanently establish electric cooking expanding. Active sales campaigns are now under way in a number of places and the orders received have been very gratifying to electric range distributors.

Orders for carload lots have not been infrequent, and in one instance within the past few weeks a single order of eight carloads, making up an entire train, was shipped.

In the Far West, where there is an abundant supply of cheap water power, electric cooking has received the greatest promotion. Throughout the Pacific and Rocky Mountain States large sums have been authorized to be used in furthering the sale of electric ranges.

The Middle West and East are not far behind. Reports just received, one from New England and the other from Indiana, show how the "Cook by Wire" idea is taking hold.

W. B. Pierce, Eastern representative of the Hughes Electric Heating Company, who opened a district office at Boston, Mass., about March 1, reports the sale of about three carloads of electric ranges in the past eight weeks, with a rapid increase in the volume of orders. The company is vigorously co-operating in the electric range campaign of the Edison Electric Illuminating Company of Boston. Range campaigns have also been inaugurated on the properties of the Twin-State Gas & Electric Company, with headquarters at Dover, N. H., and on the Stone & Webster central station system at Brockton, Mass. Among the latest purchasers of large electric ranges is Simmons College, Boston, where the equipment will be utilized in the domestic science classroom.

The Muncie Electric Light Company has inaugurated an electric range campaign, to continue during May, at Dunkirk and Redkey, Ind., two of the smaller towns supplied with energy from its lines. At both towns time payments are granted to purchasers of ranges and trial installations are permitted. The installation charge is included in the list price of the stove, and demonstrations are given to show the advantages of this method of cooking. Globe electric ranges, manufactured by the Globe Stove & Range

Company, Kokomo, Ind., are being used exclusively, and in accordance with the Globe company's policy a factory sales representative is in charge of the campaigns.

Record Electrical Exports in February

Exports of electrical goods of American manufacture reached a high level for the month of February last. During that month there were exported, according to the monthly summary of the Bureau of Foreign and Domestic Commerce, electrical apparatus and appliances to the value of $2,942,611, which is compared with the February, 1915, exports of $1,683,567.

In comparison with February of last year the largest increase in this past February's exports was in miscellaneous supplies and amounted to more than $800,000. Other notable increases were in insulated wire and cable, $200,000; interior wiring supplies, $65,000; metal filament lamps, $50,000; motors, $110,000, and transformers, $40,000. Telephone exports, which with the exception of September have been consistently smaller than during the corresponding month of a year previous, amounted to $105,176 during February, 1916, as compared with $101,957 in February, 1915. Batteries, on the other hand, which have been showing increases every month, were slightly less in February, 1916, than in February, 1915. The respective figures are $104,712 and $109,214. Generators, as usual, showed a decrease although not as great as is customary.

February exports brought the totals for the eight months ended February, 1916, more than 50 per cent above those for the eight months ended February, 1915, and 6 per cent above those for the eight months ended February, 1914. The respective figures for these periods were $18,581,180; $12,205,421 and 17,723,804.

These figures, as will be noted, are for values only and not quantities. For that reason strict comparisons should not be made. In fact, it is extremely doubtful if the electrical export trade as a whole is really increasing. Prices have advanced so materially during the past half year, for one reason or another, that comparisons of volumes of business based on values only are very apt to be misleading. Especially would this be true for insulated wire and cable which has been doubled in price in the last year or so. The increases that have been made in the prices of motors for domestic consumption, if maintained for foreign trade, would more than eat up the apparent increase shown above. Moreover, the same is in a large measure true of transformers and interior wiring supplies.

On incandescent lamps price increases have not been made and consequently there is a real increase in this trade commensurate with the advance in value of exports. Materials and labor for their manufacture have increased as with other products, but increasing production has kept the factory costs down and rendered unnecessary any advance in price.

Also, many of those items which showed a decrease in total value of exports would, if prices were taken into consideration, make a decidedly poorer showing, especially those requiring large amounts of copper or castings, or in which the labor charge is a large part of the production cost.

	February		Eight Months Ended February	
	1915	1916	1915	1916
Batteries	$109,214	$104,712	$519,165	$926,924
Dynamos or generators	127,565	112,965	1,374,137	965,713
Fans	10,206	30,637	98,906	234,466
Insulated wire and cables	95,641	217,764	765,381	1,919,157
Interior wiring supplies, etc., including fixtures	67,648	133,500	418,072	628,971
Arc lamps	8,031	1,761	24,995	12,168
Carbon filament lamps	9,862	12,898	47,100	115,893
Metal filament lamps.	51,373	107,715	272,482	792,079
Meters and other measuring instruments	22,807	59,170	220,749	508,121
Motors	326,224	439,769	1,965,356	2,722,811
Telegraph instruments, including wireless apparatus	5,589	2,542	50,069	96,117
Telephones	101,957	105,176	905,133	554,108
Transformers	46,646	86,414	455,398	606,949
All other	700,804	1,527,588	5,088,478	8,497,703
Total	$1,683,567	$2,942,611	$12,205,421	$18,581,180

Manufacturing and Industrial

The Robert A. Keasbey Company, dealer in pipe and boiler coverings and rubber packings, has moved from 100 North Moore Street to Bank and West Streets, New York.

The Reeves Electric Company, Montgomery, Ala., electrical dealer and contractor, has established a branch office at Conti Street and St. Emanuel Street, Mobile, Ala.

E. H. Helms has opened at 16 North Washington Street, Hutchinson, Kan., an establishment for handling "U. S. L." batteries and starting systems and "Ever-Ready" batteries.

The Ward Leonard Electric Company.—John B. Sebring, Pittsburgh representative of the Ward Leonard Electric Company, Bronxville, N. Y., has moved his offices to 901 Park Building. G. H. Armstrong has recently joined the Sebring organization.

The Western Agencies Company, recently organized in San Francisco with offices and stockrooms at 249 Minna Street, is representing a number of well-known manufacturers of lamps, flashlights, auto specialties, and other similar materials. The president and general manager of the company is Nicholas Abrams, formerly connected with the Interstate Electric Novelty Company.

Carbon Imports.—For the quarter ended Sept. 30, 1915, the imports of carbon for electrical purposes to the United States amounted to $37,921. Of this amount $29,293 was for electrodes for electric furnaces, electrolytic and battery purposes, brushes, plates, and disks; $5,334 was for lamp black or retort lighting carbons; $1,822 for petroleum coke lighting carbons and $1,472 for flaming arc carbons.

The E. A. Bruce Electric Company.—The name of the Bruce-Heustis Electric Company, Fitchburg, Mass., electrical contractor and dealer, has been changed to the E. A. Bruce Electric Company. The change in the name of the organization has been brought about by the withdrawal of A. E. Heustis from the firm, whose place will be taken by E. E. Willard, formerly with the electrical department of the Amherst Gas Company.

The Mohawk Electrical Supply Company, Syracuse, N. Y., has leased a six-story and basement building, occupying a plot 112 ft. by 21 ft., at 325 South Warren Street, and after extensive alterations and improvements the company will move into this building, it is expected about June 1. In this new location the company will have its retail department and offices in the same building as its warehouse, which have heretofore been separate.

Standard Underground Cable Company.—The increase in the volume of wire and cable business has caused the Standard Underground Cable Company to again divide the territory which was formerly served by its Chicago office. The latest division was made when an office was established at 717 Plymouth Building, Minneapolis, Minn., and placed in charge of Harold K. Weld. An office was established in Detroit about a year ago. The location of the company's Chicago office has also been changed from the Rookery Building to 1558 Conway Building.

The Benjamin Electric Manufacturing Company, Chicago, Ill., has appointed William T. Blackwell a member of its New York department. Mr. Blackwell has been in the lighting business for the past fifteen years, having been connected with the East River Gas Company and the lighting department of the city of New York. He will have his headquarters at 114 Liberty Street. The Benjamin company has also appointed Irving J. Chesley, who has been associated with the New York office of the company for the past four years, to look after part of its business in New York and northern New Jersey.

Electrical Apparatus on Exhibition at Newark Industrial Exposition.—As a part of the centennial celebration in Newark, N. J., there will be held an industrial exposition from May 13 to June 3 at which there will be exhibited the products of a number of electrical manufacturers. In addition to the Public Service Electric Company there will be represented the Splitdorf Electric Company, Crocker-Wheeler Company, Edison Storage Battery Company, I. R. Nelson Electric Repairing & Manufacturing Company, Ideal Fire Detector Company, General Electric Company and the Westinghouse Electric & Manufacturing Company.

Emil Hemming, formerly vice-president and general manager of the Hemming Manufacturing Company, Garfield, N. J., severed his connections with the company on April 18.

Electric Range Window Display Gratis.—The Hughes Electric Heating Company, Chicago, has prepared and has ready for free distribution a ten-color, eighteen-piece window display. This elaborate piece of publicity has been worked up for central station customers of the Hughes company in such a manner that it can be placed in any window with little effort. It points out the principal advantages of electric cooking and contains placards from which streamers can be run to the features of the range in the center of the window.

Increasing Electric-Furnace-Manufacturing Facilities.—The American Bridge Company, which is manufacturing electrically operated furnaces under the Heroult patents, is arranging to make an addition, it is reported, to its electric-furnace-manufacturing facilities at the Pencoyd plant at Philadelphia. Complete units of this type of steel-making equipment are made at this plant and at the Ambridge plant. It is also thought that added facilities for making electric furnaces will be made at the Gary plant of the United States Steel Corporation.

Electrical Trading Stamp Company.—The Federal Profit Sharing Company has been formed in Chicago and already has contracted with the Commonwealth Edison Company for the use of its profit-sharing service. The Commonwealth Edison Company will give stamps, or dividend coupons, as they are called, with all sales of merchandise made in its electric shops or by its field salesmen. No coupons will be given, however, with sales of supplies. The company's present newspaper advertising is carrying the following announcements: "Big value in Federal Dividend Coupons given with all merchandise sales at electric shops and branch stores."

Chain Belt Company Insures Employees Under Group Plan.—The new idea of group insurance for employees has been adopted by the Chain Belt Company of Milwaukee, Wis., whose officers wish to do something which would be an incentive for continuous and faithful service of its workmen. A letter was written by President W. S. Frye to each employee announcing and explaining the plan. Under the single policy written to the company, each employee who has been with the concern two years or more is given a straight life insurance to the amount of $1,000, and those who have been employed less than two years are insured for the sum of $500. In the latter class, those who complete two years' service will be given the $1,000 policy.

General Electric Engineers Convene in New England.—Engineers from district offices of the General Electric Company in all parts of the country convened at Pittsfield and Lynn, Mass., recently, to study the latest improvements in equipment design and to discuss with the factory engineers at each place future tendencies and modifications in apparatus construction and layout. At the Pittsfield works General Manager C. C. Chesney opened the convention, and addresses were delivered by G. Faccioli, electrical engineer; W. S. Moody of the transformer department; V. E. Goodwin of the lightning arrester department; J. P. Catlin of the motor department; C. P. Randolph of the heating-device department, and E. D. Eby of the bushing department. Shop visits and demonstrations of high-voltage phenomena formed a part of the first day's sessions, and on Monday evening the visitors, local engineers and assistants and department heads dined at the Hotel Wendell, among those present being E. W. Rice, Jr., president; Francis C. Pratt, assistant to the president; George E. Emmons, vice-president, and Fred M. Kimball, superintendent of the small-motor department at Lynn. It was planned to open the Lynn sessions Wednesday with General Manager W. C. Fish of the Lynn works in the role of host.

Westinghouse Automobile Department Activities.—A contract has recently been signed by the Murray Motor Car Company of Pittsburgh, Pa., for Westinghouse starting and lighting equipment for its new car. The equipment will consist of a round-type starting motor operated by screw pinion shift and a round-type lighting generator. The Westinghouse Electric & Manufacturing Company has recently arranged with the following concerns to provide service stations: Arthur Jones Electric Company, 55 East Twenty-eighth Street, Chicago, Ill.; East William Street Garage, 245 East William Street, Decatur, Ill.; Fitch Auto Supply Company, 704 Main Street, Peoria, Ill.; Central Electric Garage, 407 East Jackson Street, Springfield, Ill.; W. H. Hamilton, 100 East Chestnut Street, Jefferson, Ill. An increase in the retail price of Westinghouse starting and lighting equipment for Ford cars to $85 has recently been made. This increase has been brought about on account of the high cost of raw materials. Marshall W. Hanks, who is in charge of the Western sales of the automobile equipment department of the Westinghouse company, now has his headquarters in Chicago. Mr. Hanks was formerly connected with the sales service station of the company at Indianapolis. The service work at Indianapolis is now handled by the Kelly Springfield Company of Indiana, and the sales of the Westinghouse equipment in this district by H. H. Johnson. R. C. Ritchie, formerly in charge of the office of the automobile equipment sales service station of the Westinghouse company in Chicago, has been transferred to the main office at the Shadyside Works, Pittsburgh, Pa.

NEW YORK METAL MARKET PRICES

	May 2 Selling Prices Bid	May 2 Selling Prices Asked	May 9 Selling Prices Bid	May 9 Selling Prices Asked
Copper	£ s d	£ s d	£ s d	£ s d
London, standard spot	134 0 0		139 10 0	
Prime Lake	29.50 to 30.00†		29.75	to 30.25†
Electrolytic	30.00 to 31.00†		30.50	to 31.00†
Casting	27.50 to 28.00†		27.75	to 28.25†
Copper wire base	32.50 to 33.50†		32.50	to 33.50†
Lead	7.50†		7.50†	
Nickel	45.00 to 50.00		45.00	to 50.00
Sheet zinc, f.o.b. smelter	25.50†		25.50†	
Spelter, spot	17.55 to 17.80†		16.92½	to 17.17½†
Tin, straits	51.50†		49.75†	
Aluminum, 98 to 99 per cent.	57.00 to 59.00†		57.00	to 59.00†

OLD METALS

Heavy copper and wire	24.00 to 24.25†		23.00 to 23.50†	
Brass, heavy	14.75 to 15.00†		14.00 to 14.50†	
Brass, light	11.75 to 12.00†		11.75 to 12.00†	
Lead, heavy	6.00 to 6.25†		5.50 to 6.00†	
Zinc, scrap	15.00 to 15.50†		14.50 to 15.00†	

COPPER EXPORTS

Total tons to May 9	3,396

†Nominal.

Corporate and Financial

Associated Gas & Electric Company, New York, N. Y.—The following is the condensed result of the operations of the company and its subsidiary companies for 1915, according to its annual report:

Gross earnings from operation		$648,616
Operating expenses and taxes		386,443
Net earnings from operation		$262,173
Other income of Associated company:		
Interest and dividends		22,243
Gross income for year		$284,616
Less deductions subsidiary companies:		
Interest on bonds not held by Associated company	$50,227	
Interest on floating debt not held by Associated company	1,807	
Sinking fund	14,478	
Amortization of debt, discount and expense and fixed capital	7,380	
Dividend on stock not owned by Associated company	285	
Proportion surplus reserved for minority stockholders	1,977	
		76,154
Balance available for Associated company		$208,462
Less:		
Interest on first mortgage bond and stock collateral trust 5 per cent gold bonds	$54,481	
Interest on collateral trust 6 per cent bonds	8,700	
Interest on collateral trust five-year 6 per cent notes	36,094	
		99,275
Balance		$109,187
Dividend on preferred stock		55,422
Balance		$53,765
Amortization of debt, discount and expense		9,067
Balance		$44,698
Dividend on common stock		18,000
Surplus for year		$26,698

Buffalo (N. Y.) General Electric Company.—The Public Service Commission of the Second District of New York has authorized the issue of $3,625,287.40 of securities the proceeds from which will pay for the new steam generating station now under construction in the town of Tonawanda, and made necessary because of federal restrictions regarding the use of further water power at Niagara Falls. The commission authorized the issue of $2,498,000 of 5 per cent bonds under the first refunding mortgage, to be sold at not less than 98.13 and $1,147,000 of the common stock to be sold at not less than par. The bonds are being offered to the public for investment at 100.5 and interest. It has been announced by the company that it expects to start the new plant operating before the end of the year.

Colorado Power Company, Denver, Col.—The output of the company during 1915, according to its anual report for that year, increased from 98,100,000 kw.-hr. to 105,200,000 kw.-hr. The earnings statement for 1915 as compared with 1914 follows:

	1915	1914
Gross earnings	$837,743	$746,869
Operating expenses	$232,131	$197,157
Reservation for depreciation	81,664	66,000
Taxes	72,120	71,000
Total	$385,915	$334,157
Net earnings	$451,828	$412,712
Other income	35,316	29,828
Gross income	$487,144	$442,540
Deductions from income:		
Interest on bonds	$206,636	$206,275
Other deductions	1,481	150
Total	$208,117	$206,425
Net income for the year	$279,027	$236,115
Surplus, Jan. 1, 1915	385,059	178,648
Gross surplus	$664,086	$414,763
Dividend on preferred stock	29,718	29,704
Surplus, at end of period	$634,368	$385,059

Columbia Gas & Electric Company, Huntington, W. Va.—The annual report of the company, which leases the Union Gas & Electric Company, Cincinnati, Ohio, shows the following consolidated income statement for the years ended Dec. 31, 1914 and 1915.

Income:	1915	1914
Gross earnings	$8,044,532	$7,810,214
Operating expenses and taxes	4,143,064	3,847,010
Net earnings	$3,901,468	$3,963,204
Other income	514,178	472,520
Total gross income	$4,415,646	$4,435,724
Deductions:		
Accrued rentals	3,272,631	3,288,197
Accrued interest of the Union Gas & Electric Company	79,494	80,949
Surplus earnings of the Union Gas & Electric Company apportionable to its outstanding stock	973	586
Net income	$1,062,548	$1,065,992
Fixed charges, Columbia Gas & Electric Company:		
Accrued interest on first mortgage 5 per cent gold bonds	$517,009	$516,240
Accrued interest on 5 per cent gold debentures	126,554	123,262
Other accrued interest	38,346	35,452
Total fixed charges	$681,909	$674,954
Balance	$380,639	$391,038
Sinking fund payments	80,746	95,005
Surplus	$299,893	$296,033

Great Western Power Company, San Francisco, Cal.—The Great Western Power Company, City Electric Company, and the Consolidated Electric Company have filed with the California Railroad Commission a joint application for approval of an agreement for operation of the properties of the last-named corporation. The Great Western serves electricity and steam in Oakland and elsewhere in California. The City Electric is in the same business in San Francisco. The Consolidated Electric last October bought the electric and steam properties of the United Light & Power Company and its subsidiary companies in Oakland and San Francisco subject to the lien of the underlying bonds of $243,000, in consideration of $2,024,500 of Consolidated Electric Company's general mortgage 5 per cent bonds. The Great Western owns all of the capital stock of the Consolidated Electric. Since the taking over of the United Light & Power Company's properties and those of its subsidiary concerns, the City Electric has operated these properties in San Francisco, receiving all the revenues and paying all the expenses as well as the interest and sinking fund accruals on $100,000 of underlying bonds, and $1,320,000 of Consolidated Electric bonds, and also taxes assessed on the properties in San Francisco. The Great Western has operated the properties of the Consolidated Electric in Oakland, paying besides the expenses, the interest and sinking fund accruals on $145,000 in underlying bonds, and $704,500 of the Consolidated bonds, with taxes in Oakland. It is this plan of operation that the three companies ask the commission to approve.

Ithaca (N. Y.) Gas & Electric Company.—A comparative earnings statement for 1914 and 1915 follows:

	1915	1914
Gross revenue	$226,727	$211,746
Operating expenses	106,067	107,565
Taxes	15,350	14,225
Net revenue	$105,310	$89,956
Interest and appropriations	25,527	25,961
Net income	$79,783	$63,995

Kentucky Public Service Company, Bowling Green, Ky.—A comparative statement of the earnings of the company for 1914 and 1915 follows:

	1915	1914
Gross revenue	$269,484	$267,176
Operating expenses	147,612	156,994
Taxes	13,756	14,019
Net revenue	$108,116	$96,163
Interest and appropriations	79,539	69,007
Net income	$28,577	$27,156

Northern States Power Company, Chicago, Ill.—Seventy-seven customers of the company were added to the list of preferred shareholders during the month of April, with total holdings of $62,500 par value. This brings the total number of customer-shareholders up to 836 since the stock was first offered in the territory served by the company's subsidiaries in June, 1915. The total par value of the stock held by these customers is $492,400. April sales exceeded the total of any previous month.

Pacific Power & Light Company, Portland, Ore.—The company has purchased the property of the Seaside Light & Power Company, lighting Seaside and Gearhart, Ore., which has an estimated value of about $100,000. The plant of the Seaside company serves a large seashore resort, which has a population of about 15,000 during the summer period, but not more than 2500 in the winter months. The present plant has a capacity of about 400 hp. It is understood that the Pacific Company will extend its 22,500-volt transmission line from Warrenton to Seaside and thus furnish auxiliary power from its Astoria plant. A small telephone system is involved in the exchange of property.

Trumbull Public Service Company.—The Ohio Public Utilities Commission has authorized the company to issue $32,000 of first mortgage 6 per cent gold bonds at not less than 92. The proceeds will be used to reimburse the company's expenditures for the construction of additions, extensions and improvements to its facilities.

United Gas Improvement Company, Philadelphia, Pa.—For the fiscal year ended Dec. 31, 1915, the sales of the gas and electric properties in which the company is interested show on comparison with 1914 a decrease of 0.67 per cent in the city of Philadelphia, but outside of Philadelphia there was an increase of 3.01 per cent in sales of manufactured gas, 12.53 per cent in electricity and 8.74 per cent in natural gas. A summary of the earnings and expenses for 1915 as compared with 1914 is shown in the following table:

Earnings	1914	1915
From regular sources	$6,911,731	$7,841,390
From special sources:		
Extra dividend on stock of one of the companies in which this company is a shareholder	.....	1,230,000
Profit from sale of securities	2,172,812	.....
Total earnings	$9,084,543	$9,071,390
Expenses and taxes	1,188,143	1,074,459
Net profits	$7,896,400	$7,996,921
Dividends	4,440,236	4,440,236
Sinking funds	801,300	797,500
To undivided profit account	2,654,864	2,759,185
	$7,896,400	$7,996,921

New Utility and Industrial Companies

The Canfield Gas & Electric Company of Canfield, Ohio, has been incorporated with a capital stock of $100,000 by W. Jarvis Smith, John Rowen, Aaron Weisner, C. C. Neff and C. R. Wetmore.

The Home Electric Light & Power Equipment Company of Boston, Mass., has been incorporated with a capital stock of $75,000 by John A. High, 1688 Beacon Street, Brookline, Mass., president and treasurer; A. A. Alexander and W. Hartstone.

Collins & Moore, Inc., of Paris, Tex., has been organized by W. A. Collins and W. G. Moore for the purpose of doing a general electrical engineering, contracting and supply business, and will also carry a complete line of machinery and mill supplies.

The Reliable Electric Motor Company of Arverne, N. Y., has been chartered with a capital stock of $5,000 to manufacture electric fans, devices and equipment. The incorporators are: M. S. and H. Lippman, 212 North Vernon Avenue, Arverne, N. Y.

The Mathleu Company of Wilmington, Del., has been incorporated with a capital stock of $50,000 to manufacture electrical devices. The incorporators are: Herbert E. Latter, Norman P. Coffin, of Wilmington, Del., and Clement M. Egner, of Elkton, Md.

The Dean Electric Construction Company, 1130 Lake Street, Oak Park, Ill., has been incorporated with a capital stock of $5,000 by William Dean, E. C. Grimes and W. Steven Lewis. The company proposes to manufacture and deal in electrical supplies.

The Hartford Electric Novelty Company, 160 North Fifth Avenue, Chicago, Ill., has been chartered with a capital stock of $20,000 to manufacture and deal in household specialties. The incorporators are: William P. Hartford, George A. Hubert and Sherwin N. Bisbee.

The Battery & Starter Company of Buffalo, N. Y., has been incorporated with a capital stock of $10,000 to deal in storage batteries, electric self-starters, auto accessories, etc. The incorporators are: J. B. Rodgers, W. R. Devine and E. F. Miller of Buffalo, N. Y.

The Electric Sales Service Company of San Francisco, Cal., has been incorporated with a capital stock of $100,000 to manufacture and deal in electrical appliances. The incorporators are: W. W. Briggs, H. E. Kennedy, H. A. Mulvany, W. S. Leffler and W. S. Braun.

The Electrical Talking Sign Company of New York, N. Y., has been incorporated by C. A. Gardner, A. S. Reid and O. M. Rogers, 608 Dearborn Street, Chicago, Ill. The company is capitalized at $150,000 and proposes to manufacture electrical display advertising devices.

The Auto Electric Service Company of New York, N. Y., has been incorporated by George Strasser, 426 West Fifty-seventh Street; W. C. Wolf and Henry Berlinghof, of New York, N. Y. The company is capitalized at $5,000, and proposes to manufacture electrical apparatus for automobiles, etc.

The Interchangeable Trolley Switch Company of Syracuse, N. Y., has been chartered with a capital stock of $100,000 by C. W. Blodgett, W. A. Wright and W. Dibbs, 400 East Genesee Street, Syracuse, N. Y. The company proposes to manufacture switches, appliances for use on electric railroads.

The Electrical Prepay Meter Company of Louisville, Ky., has been chartered with a capital stock of $50,000 for the purpose of manufacturing patented devices for installing electrical machinery and to generate and distribute electricity, etc. The incorporators are: N. D. and H. R. Abell and J. D. Sheridan.

The Automatic Scoreboard Company of New York, N. Y., has been incorporated with a capital stock of $25,000 to deal in transportation, telegraph, electric conductor equipment exhibiting automatically by score cards, messages, etc. The incorporators are: S. and C. Harris, G. M. Anderson, 1520 Broadway, New York, N. Y.

The Duplex Lock Company of New York, N. Y., has been incorporated by W. A. Shanahan, H. B. Murdock and C. S. Rice, 105 William Street, New York, N. Y. The company is capitalized at $10,000, and proposes to manufacture and deal in electrical machinery, machinery, motors, electrostatic machinery, mill supplies, etc.

The Bowen Brothers Electric Light & Power Company of Phillipsburg, Mont., has been incorporated with a capital stock of $40,000 to supply electricity for lamps and motors. The officers are: Fred Bowen, Jr., president; Dr. Walter Carter, vice-president, and Clara Bowen, secretary and treasurer. The headquarters of the company will be located in Phillipsburg.

The Multicell Electric Company of Steubenville, Ohio, has been incorporated by A. T. Houser, George F. Hamilton, George B. Low, Frank S. King and O. S. Holmes. The company is capitalized at $10,000, and proposes to deal in all kinds of electrical and mechanical devices. It has taken over the product of the Sterling Corporation of Cleveland, Ohio.

Trade Publications

High-Speed Steel.—The Vanadium-Alloys Steel Company, Pittsburgh, Pa., has issued a folder which describes its "Red Cut Superior" high-speed steel.

Hand Pipe-Cutting Tools.—The Borden Company, Warren, Ohio, is sending out reprints of a paper prepared by W. A. Phillis on "The Evolution of Hand Pipe-Cutting Tools."

Automatic Controller.—The Ward Leonard Electric Company, Bronxville, N. Y., has issued folders on its Type CC automatic controller for dynamo lighting and electric starting systems.

Electric Washers.—The White Lily Manufacturing Company, Davenport, Iowa, has issued illustrated folders on its electrically operated washing machines equipped with revolving tub bench.

Electric Ranges.—The Hughes Electric Heating Company, 211 West Schiller Street, Chicago, Ill., has issued a folder printed in colors entitled, "New Low-Priced Heavy-Duty Hughes Ranges."

Semi-Indirect Lighting Fixtures.—The Luminous Specialty Company, Indianapolis, Ind., has issued an illustrated folder entitled, "Eye-Shield-Diffuser," descriptive of a semi-indirect lighting fixture.

Electric Parers.—The Maxim Manufacturing Company, 700 West Twenty-second Street, Chicago, Ill., has issued a folder descriptive of its "Sim-Peel-O" electrically operated vegetable-peeling machines.

Electric Ranges.—The Hotpoint Electric Heating Company, Ontario, Cal., is sending out an illustrated folder, entitled "The Element of Success," which contains information on its electrically operated ranges.

Transformers.—The Adams-Bagnall Electric Company, Cleveland, Ohio, has just issued an illustrated folder descriptive of several types of single-phase and three-phase transformers for lighting and power service.

Annunciator and Metal-Molding Fittings.—Edwards & Company, 140th Street and Exterior Street, New York, have published illustrated bulletins on their "San-Fer-Ann" annunciator and Stewart metal-molding fittings.

Loud-Speaking Telephone Equipment.—Catalog No. 4, published by the Stentor Electric Manufacturing Company, New York, describes "Autophones" which are designed as a substitute for the ordinary speaking tubes in limousines.

Motor-Generator Set for Motion-Picture Machines.—The C & C Electric & Manufacturing Company, Garwood, N. J., has issued an illustrated booklet descriptive of the Hill motor-generator outfit designed for motion-picture machines.

Motor-Driven House Pumps.—The Buckeye Pump & Manufacturing Company, 189 West Broad Street, Columbus, Ohio, has issued an illustrated bulletin descriptive of its "Triplex" No. 10 and No. 15 electrically operated automatic house pumps.

Automatic Air Compressor and Distributing Panel.—The Ritter Dental Manufacturing Company, Rochester, N. Y., has issued several illustrated catalogs containing information on its automatic electrically operated air compressor and distributing panel.

New England

PRINCETON, ME.—The installation of a municipal electric-light plant in Princeton is under consideration.

ATHOL, MASS.—Preparations are being made for installing cluster lamps on Exchange Street.

CONWAY, MASS.—The town of Conway has approved the proposal of the Greenfield (Mass.) Light & Power Company to take over the system of the Deerfield River Electric Light Company and furnish electricity here. The Greenfield company will rebuild the local system at a cost of about $25,000, for which surveys are now being made.

GREENFIELD, MASS. — The Turners Falls Power & Electric Company of Greenfield has applied to the Board of Gas and Electric Light Commissioners for permission to issue $1,280,000 in capital stock, the proceeds to be used to take up outstanding indebtedness and for further extensions of its plant.

HAVERHILL, MASS.—Plans are being considered for extensions to the ornamental street-lighting system.

HOLYOKE, MASS.—Steps will be taken immediately by Mayor John J. White to secure permission from the State Legislature to allow the Power Department to purchase land and erect a power building for manufacturing purposes.

RICHMOND, MASS. — The Pittsfield (Mass.) Electric Company has decided to extend its transmission line to Richmond to supply electricity to the Richmond Iron Works and for private residences.

SALEM, MASS.—The City Council has granted the Salem Electric Lighting Company permission to lay and maintain underground conduits on Bridge Street and elsewhere through adjacent streets.

SALEM, MASS.—The special committee on street lighting has recommended to the City Council the acceptance of the new proposal submitted by the Salem Electric Lighting Company for street lighting which provides for 50 6.6-amp. magnetite arc lamps mounted on ornamental posts in the business section and 1133 nitrogen-filled incandescent lamps of 400 cp., 250 cp. and 60 cp. to be erected throughout the city. The contract is for a period of five years.

SHELBURNE FALLS, MASS.—The New England Power Company of Shelburne Falls has recently sold $1,000,000 in bonds, the proceeds to be used for the acquisition of transmission lines, substations and hydro-electric generation plant on the Deerfield River. Plans have been perfected whereby the properties of the Connecticut River Transmission Company and the New England Power Company will be consodilated.

WESTFIELD, MASS.—The residents of Wyben have filed a petition with the Municipal Electric Light Department for the extension of the electric-lighting service to that village. Citizens of Middle Farms living near the brick yards also contemplate asking for an extension of about 500 ft. to secure electricity for lighting residences in that district.

Middle Atlantic

ALBANY, N. Y.—The Municipal Gas Company of Albany is planning to make extensions to its underground conduit system at a cost of $70,000.

COHOES, N. Y.—About 30 manufacturing plants, it is reported, are planning to equip their plants for electrical operation this summer.

COOPERSTOWN, N. Y.—The Town Board of Otsego has awarded the Colliers Light, Heat & Power Company of Cooperstown a contract for lighting the streets of Fly Creek with electricity for a period of ten years.

CROWN POINT, N. Y.—The town of Crown Point has granted the Port Henry (N. Y.) Light, Heat & Power Company authority to exercise a franchise to supply electrical service here. The company will extend its transmission line to Crown Point.

HERKIMER, N. Y.—The Municipal Commission is considering the purchase of a new turbine for the municipal electric-light plant.

HINSDALE, N. Y.—Arrangements are being made by the Olean (N. Y.) Electric Light & Power Company to install an electric-lighting system in Hinsdale.

LOWVILLE, N. Y.—The Wetmore Electric Company of Lowville is planning to erect a new transmission line from Lowville to the plant at Belfort, at a cost of about $20,000. Thirty-five-foot steel poles will be used.

MANCHESTER, N. Y.—Extensive improvements are contemplated in the Manchester yards of the Lehigh Valley Railroad during the coming summer, involving an expenditure of $750,000. The proposed work will include an electric power plant, new shops and a new round house. The shops which are now operated by steam power will be run by electricity.

Construction

News of Projects, Plans, Bids and Contracts. Notes on Work Under Way

NEWARK, N. Y.—Bids will be received by Albert W. Beaven, president of board of managers of the New York State Custodial Asylum for Feeble-Minded Women, Newark, N. Y., until May 25 for alterations and additions to power house, construction, heating and electric work at the New York State Custodial Asylum for Feeble-Minded Women, Newark. Drawings and specifications may be consulted at the hospital at Newark; New York office of the Department of Architecture, Room 1224, Woolworth Building, New York City, and at the Department of Architecture, Capitol, Albany. Copies of plans may be obtained on application to Lewis F. Pilcher, state architect, Capitol, Albany, on deposit of $10.

NEW YORK, N. Y.—Conners Brothers, 64 West Eighty-eighth Street, New York, will let contract for 4 miles of overhead trolley work.

NEW YORK, N. Y.—Bids will be received by C. B. J. Snyder, superintendent of school buildings, Department of Education, Park Avenue and Fifty-ninth Street, New York, until May 22 for installing electric-lighting equipment in Public Schools 56, 73, 84, 122 and 137, borough of Manhattan. Blank forms, plans and specifications may be obtained or seen at the office of the superintendent.

PLATTSBURGH, N. Y.—The Public Service Commission has approved the franchise of the Plattsburgh Gas & Electric Company in Plattsburgh. The company is already operating a plant at Indian Rapids and supplying a small amount of energy in the hamlet of Morrisville, and now proposes to extend its service to other points in the town.

ROCHESTER, N. Y.—Bids will soon be asked by the purchasing agent of Monroe County for construction of power house, 33 ft. by 100 ft., one story high, for the Iola Sanitarium. The cost is estimated at about $24,000. Hutchinson & Cutler, Cutler Building, Rochester, are architects.

SODUS POINT, N. Y.—A petition has been presented by the taxpayers to the Town Board asking for the creation of an electric light district in the village.

UNION SPRINGS, N. Y.—The Public Service Commission has authorized the Union Springs Light & Power Company to issue $25,000 in bonds, of the proceeds $12,000 will be used for refunding purposes. The company will install 100-hp. engine and boiler and a 100-kw. generator with necessary appurtenances.

WATERTOWN, N. Y.—The Council has authorized the Board of Public Works to install ornamental lamps on Factory Street from Mill Street to Factory Square, at a cost of $2,000.

WILLSBORO, N. Y.—The Public Service Commission has granted the Boquet Electric Power Company of Willsboro permission to issue $5,000 in capital, the proceeds to be used for the installation of a new 160-hp. horizontal water wheel, a three-phase, 60-cycle, 2300-volt generator, pipes and electrical equipment for the new unit.

BERRYSBURG, PA.—Application will be made to the Governor of Pennsylvania by John Pfeiffer, B. W. Fees, G. Schoffstall, W. N. Snyder and Harper P. Bressler for a charter for the Berrysburg Electric Company, which proposes to supply electricity in Berrysburg.

ERIE, PA.—The Council has recommended for passage an ordinance providing for the installation of a four to twelve-duct low-tension conduit in Tenth Street, from Peach Street to Cascade Street, to cost about $10,000.

GRATZ, PA.—Application will be made to the Governor of Pennsylvania on May 16 for a charter for the Gratz Electric Company to supply electricity in Gratz. The incorporators are: John Pfeiffer, B. W. Fees, G. Schoffstall, W. N. Snyder and Harper P. Bressler.

HALIFAX, PA.—Application has been made to the Governor of Pennsylvania for charters for the Upper Paxton Township Electric Light, Heat & Power Company, the Halifax Township Electric Light, Heat & Power Company and the Halifax Electric Light, Heat & Power Company, which propose to supply electricity in the borough of Halifax.

VARDEN, PA.—Application has been made by A. F. Kizer, W. W. Kiser and others for a charter for the Varden & Lake Ariel Electric Light, Heat & Power Company to furnish electricity in Varden and Lake Ariel and adjacent territory.

ELIZABETH, N. J.—Plans are being prepared by Samuel L. Moore & Sons, Front Street, Elizabeth, for the construction of a power house, 60 ft. by 140 ft., one story, to cost about $25,000. Ring, Cleaves & Graham Company, 280 North Broad Street, Elizabeth, are architects.

JERSEY CITY, N. J.—The City Commissioners have decided to erect ornamental lamps (similar to those ordered for Central Avenue) on Grove Street, from Newark Avenue to the Hoboken city line.

NEWTON, N. J.—A committee has been appointed by the Board of Trade to confer with the Newton Township Committee with a view of replacing the present gasolene street-lighting system with electric street lamps.

FREDERICK, MD.—The Frederick & Hagerstown Railway Company has submitted a proposal to the Town Council offering to light the town for $5,000 per year.

EAGLE, W. VA.—The mines of the Rail & River Coal Company at Eagle are being equipped for electrical operation. Electricity will be supplied from the Montgomery plant of the West Virginia Light & Traction Comany. The latter secures energy from the central power station of the Virginia Power Company at Cabin Creek Junction, 10 miles west of the Kanawha River. J. N. Gallatly of Eagle is general manager of the coal company.

FAIRMONT, W. VA.—The Monongahela Valley Traction Company is contemplating the installation of 1150-kw. generator driven by gas engine in its central power plant in Fairmont.

VIVIAN, W. VA.—The Sycamore Coal Company of Vivian has closed a contract with the Tug River Power Company for electricity and will make extensive additions to its electrical equipment.

VULCAN, W. VA.—The Vulcan Coal Company has discarded its old power plant and now obtains energy from the central plant of the Tug River Power Company at Spriggs. A large amount of electrical equipment is being installed by the Vulcan company. Roger Martin of Vulcan is general manager.

WARWOOD, W. VA.—The Council is considering the installation of a new street-lighting system, bids for which will soon be asked.

WASHINGTON, D. C.—The Potomac Electric Power Company of Washington is contemplating the construction of a power plant on Benning Road northeast, to cost about $25,000.

North Central

GREENFIELD, MICH.—The Highland Park & Royal Oak Railway Company has been granted a franchise by the property owners of Greenfield Township to construct and operate an electric railway from Highland Park through the township to Royal Oak. Robert E. Barber, John L. Austin and others are interested in the project.

CANTON, OHIO—A permit has been granted to the Canton Electric Company for remodeling its engine house located on Elm Street. The cost of the equipment for the building is estimated at about $40,000.

CLEVELAND, OHIO—Plans are being considered by the Cleveland Illuminating Company for the construction of a new substation at 2497 East Fifty-fifth Street, to cost about $35,000.

LOWELLVILLE, OHIO—The addition to the power house of the Mahoning & Shenango Railway & Light Company at Lowellville is practically completed. By this addition the capacity of the three generating stations of the Mahoning and Shenango system has been doubled. The new steam generating equipment comprises batteries of 600 hp. Babcock & Wilcox boilers, with provision for the installation of additional boilers of the same type. A new engine-driven fan of 60,000 cu. ft. per minute capacity has been installed to serve the boilers. The boilers are fed by centrifugal pump, operated by steam turbine, having a capacity of 1000 gal. per minute, fed by mechanical stokers. The new electric generating equipment consists of one 18,750-kva. General Electric turbo-generator unit, condenser and all auxiliary apparatus. The new generator has its own exciter unit, which may be driven by a turbine as well as an induction motor. In making the extension all the essentials, both in generating and transmission equipment, have been dupli-

cated. South of the new building an outdoor transformer and switching station is being erected. The Stone & Webster Engineering Corporation of Boston, Mass., has the contract for the work.

MANSFIELD, OHIO—The Mansfield Electric Light & Power Company has applied to Board of County Commissioners for a blanket franchise to erect electric transmission lines throughout Richland County. The company proposes to supply electricity to farmers in the county.

SIDNEY, OHIO.—The installation of a municipal electric-light plant in Sidney is under consideration.

WINGO, KY.—Plans are being considered for the installation of a municipal electric-light plant, to cost about $10,000. W. D. Mullins is chairman of light committee.

BRISTOL, IND.—The property of the Bristol Light & Power Company has been purchased by the Hawks Electric Company of Goshen. Work will be begun at once by the Hawks company on the erection of a transmission line between Bristol and Goshen to supply electricity here. As soon as the line is completed a 24-hour service will be established.

LA GRANGE, IND.—Arrangements are being made by the La Grange County Light & Power Company for the installation of new boilers, already purchased.

MARION, IND.—The plant of the Delta Electric Company of Marion was partially destroyed by fire, causing a loss of about $25,000.

MICHIGAN CITY, IND.—The City Council has passed a resolution providing for changing the arc lamps now in use for 400-cp. nitrogen-filled lamps. The street-lighting service is furnished by the Northern Indiana Gas & Electric Company.

PERU, IND.—The installation of a new street-lighting system on Broadway is under consideration by the City Council.

WINCHESTER, IND. — The city has awarded the Citizens' Heat, Light & Power Company a contract for street-lighting for a period of 15 years. Plans for the installation of an ornamental lighting system are under consideration.

AURORA, ILL.—Bonds to the amount of $75,000 have been voted for improvements to the electric-light plant and water-works system.

CAIRO, ILL.—The Illinois Public Utilities Commission has approved a contract for the sale by the Cairo & St. Louis Railway Company to the Cairo Electric & Traction Company, both of Cairo, of electrical energy to operate the street car and electric distributing systems in the cities of Cairo, Mounds City and Mounds.

GENEVA, ILL.—Bids will be received by the State Board of Administration, Capitol Building, Springfield, until June 6 for construction of gymnasium building at the State Training School for Girls, Geneva. Separate bids to be submitted on general work, plumbing, heating and electrical work. Plans and specifications may be obtained on written application to James B. Dibelka, state architect, 130 North Fifth Avenue, Chicago, upon deposit of $10.

JOLIET, ILL.—Bids will be received by Michael F. Zimmer, warden, and board of prison commissioners of the Northern Illinois State Penitentiary, Joliet, until May 26 for furnishing battery of boilers, aggregating 1200 hp., with a safe working pressure of 150 lb. to sq. in., for power house for penitentiary. Specifications may be obtained at the office of the chief engineer.

MANSFIELD, ILL.—The Mansfield Electric Company has applied to the County Commissioners for a franchise to erect and operate transmission lines throughout Richland County.

OGDEN, ILL.—The City Council is considering the installation of an electric-lighting system, to cost about $3,500.

MILWAUKEE, WIS.—The Wisconsin Power, Light & Heat Company of Milwaukee, recently incorporated with a capital stock of $1,000,000, by John I. Beggs, H. C. Mack and Charles J. Davison of Chicago, Ill., proposes to supply light and power to a number of smaller cities in southern Wisconsin from the power houses at Prairie du Sac and Kilbourn.

GAYLORD, MINN.—The erection of a transmission line to supply electricity in Henderson, Arlington, Gaylord, Winthrop and Gibson is under consideration by the Northern States Power Company.

GILBERT, MINN.—The installation of an electric-lighting system in Gilbert is under consideration.

GLYNDON, MINN.—Local business men are negotiating with the Union Light, Heat & Power Company of Fargo to extend its transmission from Dilworth to Glyndon, a distance of 3 miles, to supply electrical service here.

GRAND MEADOW, MINN.—Bids will be received by P. T. Elliott, clerk of board of education, Grand Meadow, Minn., until May 18 for construction of a high and grade school building. Separate bids to be submitted on general construction work, plumbing, heating and ventilating and electrical work. Plans and specifications may be obtained on application to Stebbins & Haxby, architects, Auditorium Building, Minneapolis, Minn., upon deposit of $20.

HENDRICKS, MINN.—The Hendricks Light & Power Company, it is reported, is contemplating the construction of a new power plant.

PERHAM, MINN.—Bids will be received by Mike Goblirich, secretary of school board of school district No. 44, Otter Tail County, City Hall, Perham, Minn., until May 24 for construction of high school building and remodeling of an old high and grade school building. Separate bids to be submitted on general construction, heating and ventilating, electrical work, plumbing, science and laboratory equipment, gymnasium equipment and seating. Plans and specifications may be obtained on application to G. L. Lockhart, architect, Endicott Building, St. Paul, upon deposit of $10.

ST. PAUL, MINN.—A permit has been granted the Northern States Power Company for the erection of a transformer station on Myrtle Avenue, between La Salle Street and Hampden Avenue, at a cost of $10,000.

ST. PAUL, MINN.—Bids will be received at the office of the supervising architect, Treasury Department, Washington, D. C., until June 7 for air washers, tempering coils, etc., in the United States post office, court house and custom house at St. Paul, Minn. For details see proposal columns.

ADAIR, IOWA—At an election held recently the proposal to sell the municipal electric-light plant to the Iowa Railway & Light Company of Cedar Rapids was carried. The company will soon establish a 24-hour service.

DOUDS LEANDO, IOWA—Bids will be received by the consolidated school district of Douds Leando, Iowa, until May 19 for construction of a school building, including plumbing, heating and ventilating and electrical work. Plans and specifications may be obtained on application to H. W. Underhill & Company, architects, Bryant Building, Kansas City, Mo., upon deposit of $10.

ELKADER, IOWA—Schmidt Brothers & Company of Elkader contemplate extending their transmission lines to Guttenberg, a distance of 12 miles, and will also install one 300-hp. water wheel, two 225-kva. generators, one 200-hp. crude oil engine and three 50-kva. transformers. C. G. Schmidt is superintendent.

IOWA CITY, IOWA—Extensions will be made to the lighting and heating systems at the University of Iowa and a new water system provided. An additional engine and two generators and boilers will be installed in the power plant.

UTE, IOWA.—The installation of an electric-light plant in Ute is under consideration.

WATERLOO, IOWA—The contract for the construction of the power dam across the Cedar River near Nashville for the Citizens' Gas & Electric Company of Waterloo is reported to have been awarded to the H. A. Maine Company of Waterloo.

LABELLE, MO.—Plans are being prepared by H. W. Knight of La Belle for the construction of an electric railway between Keokuk, Iowa, and Jefferson City, Mo.

ST. LOUIS, MO.—A bill appropriating $12,500 for an emergency survey of St. Louis to obtain information on which to recommend the installation of a municipal electric-light plant has been introduced in the Council by Alderman Barney L. Schwartz, chairman of the special committee to investigate the rates and holdings of the Union Electric Light & Power Company.

ST. LOUIS, MO.—Bids will be received by Dr. A. T. Laird, secretary of sanitarium commission, County of St. Louis, at the office of Holstead & Sullivan, Palladio Building, St. Louis, until May 27 for construction of a two-story annex and a three-story addition to present boiler house. Separate bids to be submitted on general work, plumbing, heating and electric wiring. Plans may be obtained on application to the architects upon deposit of $25.

WALNUT GROVE, MO.—The installation of an electric-lighting plant in Walnut Grove is under consideration. L. F. Wade of Osceola is reported interested.

CASSELLTON, N. D.—The local electric-light plant has been purchased by the General Utilities Company of Fargo.

LEITH, N. D.—Bids will be received by the Leith Equity Exchange until May 20 for construction of about 30 miles of telephone line. Plans are on file with J. L. Cahill of Leith.

MINOT, N. D.—The City Council is considering an extension to the ornamental lighting system on Main Street.

ALCESTER, S. D.—The town officials are negotiating with Louis Wagner, owner of the Beresford electric plant, to extend his electric transmission to Alcester to supply electricity here. Bonds to the amount of $10,000 were recently voted for the installation of a municipal plant.

CLARK, S. D.—The installation of an electric-light plant in conjunction with the present municipal gas plant and water-works system is under consideration.

JAVA, S. D.—Plans are being considered for the installation of a municipal electric-light plant, for which bonds have been voted.

BEATRICE, NEB.—The City Commissioners are considering submitting to the voters the proposal to issue $20,000 in bonds for extensions to the municipal electric plant at the special election to be held May 31. It is proposed to equip the plant to supply energy for commercial purposes.

BRADSHAW, NEB. — Bonds to the amount of $3,000 have been voted for the installation of an elctric-light plant.

GUIDE ROCK, NEB.—Application has been made to the town of Guide Rock by N. L. Ball to install an electric-light plant.

HOLBROOK, NEB.—An election will soon be held to submit to the voters the proposal to issue $8,000 in bonds for the installation of a municipal electric-light plant.

BONNER SPRINGS, KAN.—The Bonner Springs Electric Light Company has contracted to supply energy in Eudora, 16 miles distant, to operate the municipal electric system to be installed there.

EASTON, KAN.—Bonds to the amount of $6,000 have been voted for the installation of a municipal electric-lighting system.

GREEN, KAN.—At an election to be held May 16 the proposal to issue $4,000 in bonds will be submitted to the voters.

LOST SPRINGS, KAN.—The installation of a municipal electric distributing system is under consideration. Energy to operate the system will be obtained from the electric plant in Herington.

NETAWAKA, KAN.—The Council contemplates calling an election to submit to the voters the proposal to issue bonds to install electric-light plant.

NORCATUR, KAN.—The City Council has decided to call an election to submit to the voters the proposal to issue $22,500 in bonds for the installation of a municipal electric-light plant.

NORTON, KAN.—Preliminary plans for the proposed municipal electric-light plant are being prepared by Black & Veatch, engineers, Interstate Building, Kansas City, Mo.

TOPEKA, KAN.—The A. W. Hughes Company of Chicago, Ill., it is reported, has purchased or taken options on the electric plants at Concordia, Abilene, Junction City, Manhattan and Blue Rapids, and is negotiating for plants in other towns in that section and adjacent to the Blue River. The company is seeking control of the undeveloped power at Blue Rapids and other sites on the river, which it proposes to develop and transmit energy to towns in North Central Kansas.

Southern States

COCOANUT GROVE, FLA.—The Cocoanut Grove Public Utilities Company, recently incorporated with a capital stock of $25,000, contemplates the installation of an electric-light plant here. T. H. Wyatt is vice-president and manager.

MOORELAND, FLA.—Bonds to the amount of $25,000 have been voted for the installation of an electric-light plant and water-works system in Mooreland.

SEFFNER, FLA.—The Tampa & Eastern Railroad Company is contemplating the construction of a power station to supply electricity for lamps and motors for railway. E. J. Binford of Tampa is manager.

BARTLETT, TENN.—The installation of a street-lighting system in Bartlett is under consideration.

CHATTANOOGA, TENN.—The Cumberland Telephone & Telegraph Company is contemplating the reconstruction of its local system, at a cost of about $850,000.

CLARKSVILLE, TENN.—The trustees of the Independent Order of Odd Fellows' Home are planning to install an electric-light plant.

ATTALIA, ALA.—The National Pipe & Foundry Company contemplates the construction of a large soil-pipe factory in Attalia. The plant will be equiped with electrically-driven machinery. Energy will be obtained from the Alabama Power Company of Birmingham.

MARIANNA, ARK.—The Arkansas Light & Power Company has awarded contracts and work is now under way for improvements to its local system, including the construction of new power house, to be equipped with one 75-kw. and one 100-kw. belted unit (from old power house), one new 300-kva. General Electric generator (directly connected), one Allis-Chalmers Corliss engine, one new feeder panel and one new generator panel to be added to General Electric switchboard, boilers set in steel settings, rebuilding distribution system; electrically - driven centrifugal pumps are to be installed at water plant, which is now operated by the Arkansas Company. J. L. Longino is secretary.

NEWPORT, ARK.—The City Council has granted the Newport Water, Light & Power Company a franchise to construct and operate an electric-light plant in Newport.

ALVA, OKLA.—The city of Alva has granted a franchise for the installation of an electric-light plant.

COMMERCE, OKLA.—The Empire District Electric Company of Joplin, Mo., has applied for a franchise to supply electricity in Commerce.

HENRYETTA, OKLA.—The City Council is considering the installation of electrically-driven pumps in the water pumping station. The proposition provides for the city to generate electricity to operate the pumps.

TULSA, OKLA.—A proposal has been submitted to the Tulsa Chamber of Commerce by John R. Rose, president of the Oklahoma & Electric Railway, offering to construct an interurban line to Tulsa with terminal and shops to be located in this city.

CHAMPION, TEX.—The Texas Southern Electric Company is planning to make extensive improvements to its local system, work on which will begin at once. M. E. Pittman is local manager.

EL PASO, TEX.—Bids will be received at the office of the depot quartermaster, El Paso until June 3 for installing electrically operated equipment in pumping plant at Fort Bliss, Tex. Further information on application.

FRANKLIN, TEX.—Preparations are being made for the construction of a new municipal water and light plant, material for which has been purchased.

JACKSBORO, TEX.—The electric plant of the Jacksboro Ice & Light Company has been purchased by the Jacksboro Mill & Elevator Company. New machinery will be installed at an early date, extensions will be made to the distribution system, and a 24-hour service established. J. P. Hackley is manager.

TEXAS CITY, TEX.—Bids will be received by E. B. Gray, city secretary, Texas City, until May 30 for furnishing material and installing street-lighting system in Texas City. Plans and specifications are on file in the office of the secretary.

Pacific States

EVERETT, WASH.—The County Commissioners have granted the city of Everett a 25-year franchise to construct water pipe line and electric transmission lines across and along the various county highways on the route of the proposed line from the Sultan Basin to Everett.

GRANDVIEW, WASH.—The Board of County Commissioners has granted the petition of the Grandview Irrigation District for a franchise to erect and operate electric transmission lines for a period of 50 years. The proposed system is to be used in connection with the work of the United States Reclamation Service.

SEATTLE, WASH.—Bids will be received by C. E. Remsberg, secretary of port commission, Port of Seattle, Bell Street Warehouse, Seattle, until May 24 for refrigerating and electrical equipment for the Fruit Storage Building, of what is known as the East Waterway Terminal Improvement of the Port of Seattle. Plans and specifications are on file in the office of the commission. Bidders are invited to submit alternative bids upon designs of their own. The cost is estimated at $65,000. J. R. West is chief engineer.

SNOHOMISH, WASH.—Plans are being considered for the installation of a municipal electric-lighting plant in Snohomish.

BEND, ORE.—The Bend Water, Light & Power Company is installing a 500-hp. turbine and is planning to install a 350-kw. generator and a 10-panel switchboard.

MYRTLE CREEK, ORE.—A report has been submitted by M. B. Germond, engineer, of Roseburg, on the proposed municipal electric-light plant. The plans provide for the construction of a dam on the Umpqua, approximately 240 ft. long, a wooden flume 3200 ft. long and a power house at the end of the canal. The cost is estimated at $29,094.

PORTLAND, ORE.—Bids will be received by R. H. Thomas, school clerk, Court House, Portland, until May 18 for electric wiring and conduit work for the second unit of the Franklin High School, under construction.

SEASIDE, ORE.—The Pacific Power & Light Company of Portland has purchased the property of the Seaside Light & Power Company, which supplies electricity and operates a telephone system in Seaside and Gearhart. The Pacific company, it is understood, will extend its 22,500-volt transmission line from Warrenton to Seaside. The local plant has a capacity of 400 hp.

FONTANA, CAL.—The Fontana Power Company, recently organized, has filed a petition with the State Railroad Commission for authority to do a general utility business. The company states that it plans to build a power plant and transmission system, which it proposes to lease to the Southern California Edison Company of Los Angeles for a period of 30 years. The Edison company will furnish energy to a number of companies allied with the Fontana company.

HUNTINGTON BEACH, CAL.—The City Trustees are negotiating with the Pacific Light & Power Corporation, the Southern California Edison Company and the Sounthern Counties Gas Company for the installation of 300 additional ornamental lamp posts to be erected throughout the residence section of Huntington Beach.

LAKEPORT, CAL.—Application has been made to the State Railroad Commission by the Clear Lake Suspended Monorail Company for the construction of a monorail line between Hopland and Lakeport, a distance of 24 miles. L. H. Boggs of Kelseyville; M. S. Sayre of Lakeport, and others are interested in the project.

SACRAMENTO, CAL.—A movement has been started among the Oak Park section to have electroliers similar to those in use in the main thoroughfares in the city erected along Thirty-fifth Street and Sacramento Avenue.

SAN DIEGO, CAL.—The California Railroad Commission has authorized the San Diego Consolidated Gas & Electric Company to issue $144,000 in capital stock, the proceeds to be used for extensions and improvements to its system.

SANTA ROSA, CAL.—Steps have been taken by the Chamber of Commerce for the installation of an electrolier lighting system throughout the city.

VISALIA, CAL.—The Mount Whitney Power & Light Company of Visalia has applied to the State Railroad Commission for permission to issue $450,000 in bonds, the proceeds to be used to purchase transformers now in possession of certain of its customers and for additional transformers and betterments.

HAILEY, IDAHO.—The Hailey electric plant, which has been furnishing electricity to operate the lighting system in both Hailey and Bellevue, has been closed down and energy for both towns will be supplied by the Bellevue plant. It is reported that repairs will be made to the local plant, so that it may be used as an auxiliary or in emergencies.

PICABO, IDAHO.—The Public Utility Commission has granted James R. Wheeler permission to install electric-light plants at Picabo and Carey. According to reports Mr. Wheeler will organize a company to be known as the Silver Creek Power Company, capitalized at $25,000.

WALLACE, IDAHO.—The Washington Water Power Company of Spokane, it is reported, will immediately equip properties on Placer Creek, near Wallace, for electrical operation. Several mines are to be equipped, and according to reports further operations are to be instituted in the near future by the power company.

FARMINGTON, UTAH — Negotiations have been closed whereby the Utah Power & Light Company will take over the municipal electric plant in Farmington, at $7,500. The company has been granted a 50-year franchise.

OGDEN, UTAH.—The City Commissioners are considering changing the gravity batteries for maintaining the fire-alarm system to the storage battery system.

PARK CITY, UTAH.—Plans are nearly completed for the construction of an electrolytic zinc smelter for the Daly Judge Mining Company at Park City.

SALT LAKE CITY, UTAH.—The Salt Lake & Los Angeles Railway Company, which operates a 16-mile steam road between Salt Lake and Salt Lake City and which is also purchasing material for a 4-mile extension to Garfield, has engaged H. A. Strauss, consulting engineer, Harris Trust Building, Chicago, Ill., to design and take charge of equipping the entire system for electrical operation.

SALT LAKE CITY, UTAH.—Work has been started by the Utah Power & Light Company of Salt Lake City on the erection of a transmission line from the present terminal at Springville to the coal mining region of Carbon County. The new line will be 130 miles in length and will supply energy to operate the machinery in the mines of the United States Fuel Company. The cost of the line is estimated at $250,000.

CASA GRANDE, ARIZ.—Plans have been completed by the city engineer for the proposed municipal electric-light plant for which $30,000 in bonds have been voted.

ROUNDUP, MONT.—The contract for installing the ornamental street-lighting system in Roundup has been awarded to the Butte (Mont.) Electric Supply Company. The plans provide for 41 standards carrying five-lamp clusters, to cost about $7,000.

WOLF POINT, MONT.—The City Council has granted John Listrud a franchise to install and operate an electric-light plant for a period of 25 years.

AULT, COL.—The installation of a municipal electric-light plant in Ault is under consideration.

GARDNERVILLE, NEV. — Preparations have been made for extensions to the power plant of the Douglas Milling & Power Company on Carson River.

Canada

ARTHUR, ONT.—A by-law providing for an appropriation of $15,000 for the purchase of the local electric-lighting system and for the cost of a plant to distribute energy to be supplied by the Ontario Hydro-Electric Power Commission will soon be submitted to the ratepayers.

LONDON, ONT.—The Utilities Board is contemplating an extension of the electric lighting system into London Township to illuminate quite an area to be used for camp purposes.

LONDON, ONT.—The Public Utilities Commission has authorized E. V. Buchanan, general manager, and Philip Pocock, chairman, as a committee to engage an architect to prepare plans for a hydroelectric sales building, with offices above, to cost $75,000.

TORONTO, ONT.—The City Council has approved the petition of the Toronto Hydro-Electric System for $1,248,000, to be used for extensions.

WALKERTON, ONT.—The Town Council has asked the Ontario Hydro-Electric Power Commission to submit plans and estimates for an electric-light and power distribution system, energy to be supplied from Eugenia Falls. The cost is estimated at $25,000. A. Collins is town clerk.

WELLAND, ONT.—The Town Council has appropriated $40,000 for the erection of a new transformer station asked for by the Welland Hydro-Electric Commission.

MONTMAGNY, QUE.—Plans and estimates are being prepared by J. D. Lachapelle & Company, general agents and engineers, Montreal, for purchasing of the electrical equipment for the plant being erected at Montmagny, to cost $1,000,000, for the General Car & Machinery Company.

Miscellaneous

PANAMA—Bids will be received at the office of the general purchasing officer, the Panama Canal, Washington, D. C., until May 26 for furnishing steel, iron, wire cable, wrought iron and steel pipe, chain, boiler, tubes, steel wire, car wheels, electric cable, couplings, boilers, gongs, chain blocks, panel board, watt-hour meters, electrical attachments, welding spectacles, steel tapes, insulating paper, tracing cloth, etc. Blanks and general information relating to this circular (No. 1039) may be obtained at the above office or the offices of the assistant purchasing agents, 24 State Street, New York, N. Y.; 614 Whitney-Central Building, New Orleans, La., and Fort Mason, San Francisco, Cal.

1,181,151. CIRCUIT PLAN AND CONDUIT FOR MOTOR VEHICLES; W. MacGlashan, South Bend, Ind. App. filed Feb. 5, 1913. Designed to carry all the wiring for electric cars.

1,181,200. CIRCUIT-INTERRUPTING DEVICE; C. Aalborg, Wilkinsburg, Pa. App. filed July 29, 1913. Double-throw, quick-break, knife-blade switch.

1,181,207. POLYPHASE ELECTRIC METER; W. M. Bradshaw, Wilkinsburg, Pa. App. filed June 6, 1911. Torques exerted upon movable member of wattmeter may be readily adjusted.

1,181,211. ELECTRICAL MEASURING INSTRUMENT; L. W. Chubb, Edgewood Park, Pa. App. filed April 10, 1911. Indicates the average of the instantaneous values of an alternating emf. wave of given frequency.

1,181,216. APPARATUS FOR TRANSFORMING ELECTRIC CURRENTS; E. Falkenthal, Friedenau, near Berlin, Germany. App. filed Aug. 1912. Operates with very small loss.

1,181,226. INDICATOR; O. A. Kenyon, Hastings-on-Hudson, N. Y. App. filed Feb. 5, 1915. For transmitting readings of a thermometer to a distance.

1,181,227. ELECTRIC WELDING; O. A. Kenyon, Hastings-on-Hudson, N. Y. App. filed April 16, 1915. Arc welding with means to open and close the main-line connections.

1,181,229. INSULATOR FOR TROLLEY WIRE SUPPORTS; F. P. Kobert, Milldale, Conn. App. filed Jan. 21, 1915. Strain insulator of greater strength.

1,181,236. ELECTRICAL PROTECTIVE DEVICE; P. MacGahan, Pittsburgh, Pa. App. filed Jan. 20, 1914. Relay having simple adjustments.

1,181,237. CIRCUIT INTERRUPTER; J. N. Mahoney, Wilkinsburg, Pa. App. filed Aug. 11, 1913. Concentric arrangement of circuit breakers of the reactance type.

1,181,247. ELECTRIC SPARKING IGNITER; H. M. Pope, Hartford, Conn. App. filed May 10, 1899. Magneto construction.

1,181,250. SWITCHING DEVICE; C. Renshaw, Edgewood Park, Pa. App. filed April 24, 1913. Flexible shunt construction.

1,181,260. SPEED REGULATING AND CONTROLLING DEVICE; T. A. Sammons, Dayton, Ohio. App. filed June 4, 1915. "Safetometer" for publicly accentuating and controlling speed of motor vehicles

1,181,261. OIL CAN; C. Schmidt, West Milwaukee, Wis. App. filed March 18, 1914. Flash lamp arranged to illuminate spout of oil can.

1,181,267. SWITCHING DEVICE; P. S. Turner, Chorlton-Cum-Hardy, England. App. filed May 1, 1913. For multiple-unit control.

1,181,270. ELECTRICAL MEASURING INSTRUMENT; T. W. Varley, Pittsburgh, Pa. Ap. filed March 20, 1911. Double two-pole armature in a two-pole field by special windings.

1,181,298. ADAPTER FOR CUT-OUT BLOCKS; C. B. Fithian, Philadelphia, Pa. App. filed Feb. 20, 1915. Designed for use with cartridge fuses.

1,181,343. TRAIN SIGNAL SYSTEM; L. L. Parkhill, Dawson, Pa. App. filed Jan. 20, 1915. Combines signal to telephone system.

1,181,349. MECHANICAL PLATING APPARATUS; P. T. Sealey, Akron, Ohio. App. filed Feb. 20, 1915. Particularly for plating tire rims.

1,181,362. SUPPORT FOR STORAGE-BATTERY INSULATORS; C. Ambruster, Philadelphia, Pa. App. filed April 5, 1913. Hollow conic earthenware support.

1,181,376. ELECTRIC MOTOR; C. H. J. Dilg, New York, N. Y. App. filed April 30, 1910. Designed particularly for drilling, polishing and like purposes.

1,181,399. LIGHTNING-ROD CONNECTING CLAMP; W. H. McCullough, Chicago, Ill. App. filed March 1, 1915. Adapted for any of the well-known forms of rods.

1,181,419. ELECTRIC BURGLAR-ALARM SYSTEM; J. P. Williams, New York, N. Y. App. filed March 5, 1914. Operates with alternating current.

1,181,420. ELECTRIC BURGLAR-ALARM PROTECTIVE SYSTEM FOR SAFES; J. P. Williams, New York, N. Y. App. filed May 26, 1914. Gives alarm when person enters protected area.

1,181,423. APPARATUS FOR MEASURING RONTGEN RAYS; K. Bangert, Berlin-Charlottenburg, Germany. App. filed June 9, 1914. For measuring "hardness" and "dose" of rays.

1,181,427. MEANS FOR SIGNALING OVER ELECTRIC LIGHT CIRCUITS OR POWER MAINS; A. C. Brown, Blackheath, London, England. App. filed Sept. 25, 1913. For giving fire alarms, ambulance calls, timing clocks, etc.

Record of Electrical Patents

Notes on United States Patents issued May 2, 1916, prepared by Mitchell & Allyn, 41 Park Row, New York.

1,181,440. INSULATED TERMINAL MEMBER; H. R. Edgecomb, Edgewood Park, Pa. App. filed March 2, 1912. Permanently oil and water proof and vacuum type.

1,181,445. ANNUNCIATOR OR SIGNAL; C. U. Gramelspacher, Jasper, Ind. App. filed May 17, 1915. Particularly for mail boxes.

1,181,446. ELECTROMAGNETIC RESONATOR; L. Grubman, New York, N. Y. App. filed March 16, 1914. Electromagnet serves as a base upon which all other parts are supported.

1,181,451. SWIVEL CORD GRIP FOR ELECTRIC FIXTURES; H. Hubbell, Bridgeport, Conn. App. filed Sept. 20, 1915. For clamping cord end to the cap of a separable plug.

1,181,461. TAXICAB CALL SYSTEM AND APPARATUS; E. H. Kelley, New York, N. Y. Ap. filed June 27, 1910. Coin-controlled apparatus by which call box of the A. D. T. type can be operated.

1,181,477. TROLLEY CONDUCTOR; J. Ozanich, Sunnyside, Utah. App. filed Aug. 7, 1915. Swiveling trolley engages a conductor which is covered by a protective sheath.

1,181,483. METER TESTING APPLIANCE; J. Sachs, Hartford, Conn. App. filed April 28, 1915. Switch of the blade and clip construction.

1,181,484. METER TESTING SWITCH; J. Sachs, Hartford, Conn. App. filed May 5, 1915. For testing meter without disturbing service to consumer.

1,181,486. ART OF PRODUCING MUSICAL TONES; M. L. Severy and G. B. Sinclair, Arlington Heights and Medford, Mass. App. filed Jan. 10, 1910. Causes piano strings to produce sounds of organ, violin, flute, etc.

1,181,488. COMBINED AUDIBLE ANNUNCIATOR AND VISIBLE INDICATOR; P. R. Smith, Connellsville, Pa. App. filed April 9, 1915. Bell push which shows whether tenant is out or in.

1,181,505. MAGNETIZING DEVICE FOR WHEELS; S. D. Colvin, Myrtistown, La. App. filed Nov. 13, 1915. Magnetizing coil surrounds the wheel axle.

1,181,509. PEN; J. J. Devine, Middletown, Conn. App. filed Aug. 5, 1915. Concealed bulb throws light around pen point.

1,181,513. SPRING BINDING POST; L. Ericson, Chicago, Ill. App. filed Aug. 4, 1913. Post supports spring clamp elements.

1,181,524. ARC BREAKING INSULATION BLOCK FOR ELECTRIC SWITCHES; H. Hansen, New York, N. Y. App. filed April 17, 1914. Push-button snap switch.

1,181,549. ELECTROLYTIC CELL; H. T. Shriver, West Orange, N. J. App. filed April 3, 1915. Filter-type cell with non-leaking diaphragm.

1,181,550. ELECTRIC LIGHTING; W. C. Starkey, Mansfield, Ohio. App. filed May 9, 1910. For maintaining lamps or electric cars or the like at same brilliancy.

1,181,551. ELECTRIC LIGHTING REGULATOR; W. C. Starkey, Mansfield, Ohio. App. filed Aug. 1, 1914. For car lighting.

1,181,555. PROCESS OF MAKING TARTARIC ACIDS OR THEIR COMPOUND; M. Vaygouny, Berkeley, Cal. App. filed July 21, 1910. Reduction of glyoxylates (thirty-eight claims).

1,181,556. MEANS FOR PRODUCING HIGH-FREQUENCY CURRENTS; G. Von Arco and A. Meissner, Near Berlin, Germany. App. filed April 19, 1913. Increases frequency by means of stationary transformers.

1,181,559. INTERCOMMUNICATING SELECTIVE LOCKOUT TELEPHONE SYSTEM; F. W. Adsit, Minneapolis, Minn. App. filed Dec. 8, 1914. Automatically controlled centrally energized talking circuit.

1,181,576. BROKEN DOWN INSULATING JOINT PROTECTION; S. M. Day, Rochester, N. Y. App. filed Sept. 6, 1912. Indicates break of any kind at insulating joint.

1,181,577. BONDING PIN; E. M. Deems, East Orange, N. J. App. filed Feb. 25, 1915. Insertable in relatively small hole in railway track.

1,181,582. SECTIONAL EJECTOR FOR SLUG-CASTING MACHINES; J. L. Ebaugh, New Orleans, La. App. filed March 9, 1914. Width of ejector blade may be changed to suit length of line.

1,181,593. ELECTRIC INTERLOCKING SYSTEM; W. S. Henry, Rochester, N. Y. App. filed Jan. 12, 1912. Places additional check upon the completion of the "indication" circuit.

1,181,623. ELECTRICAL CONDENSER AND MANNER OF MOUNTING THE SAME; H. R. Van Deventer, Sumter, S. C. App. filed Feb. 15, 1915. Insulating medium of condenser acts as a casing.

1,181,630. CIRCUIT CLOSER FOR FIRE-ALARM SYSTEMS; E. Barsony, Castleton-on-Hudson, N. Y. App. filed April 22, 1915. Operates on melting of thermo member.

1,181,640. LOCKING SWITCH; G. Burkhardt, Chicago, Ill. App. filed Jan. 30, 1915. For motor vehicles.

1,181,656. POLE CHANGER; C. J. Erickson, Chicago, Ill. App. filed April 22, 1907. For party telephone lines.

1,181,665. VEHICLE ELECTRIC SIGNALING DEVICE; H. H. Hirsch, Philadelphia, Pa. App. filed May 26, 1915. For mine cars and locomotives.

1,181,669. COMBINED COUNTER AND CIRCUIT BREAKER; W. C. Kelly, Hastings, Mich. App. filed Jan. 24, 1914. Particularly for electrically-driven washing machines.

1,181,679. ATTACHMENT FOR CALLING DEVICES; E. A. Mellinger, Chicago, Ill. App. filed May 9, 1913. Prevents subscriber from hastening the normal operation of devices.

1,181,686. ELECTRICAL SWITCH; G. P. Schmit, New York, N. Y. App. filed Jan. 3, 1912. Push-button operation.

1,181,690. SYSTEM OF MOTOR CONTROL; H. A. STEEN, Milwaukee, Wis. App. filed March 1, 1911. Automatic gradual and safe acceleration of motors.

1,181,705. THERMIC CIRCUIT CLOSER; R. R. Weber, Los Angeles, Cal. App. filed June 10, 1914. Pivot spring-pressed contact held by thermo body.

1,181,706. PORCELAIN KEY SOCKET MECHANISM; B. C. Webster and G. P. Knapp, Bridgeport, Conn. App. filed Sept. 23, 1915. Has a quick, snappy double make and break.

1,181,707. KEY SOCKET MECHANISM; B. C. Webster and G. P. Knapp, Bridgeport, Conn. App. filed Sept. 23, 1915. Quick-acting double make and break.

1,181,708. SUPPORT AND GUARD FOR TELEPHONE WIRES; G. W. Welch, Decorah, Iowa. App. filed Sept. 14, 1915. Protects phone wires from high-voltage wires.

1,181,710. TELEPHONE RECEIVER; B. D. Willis, Chicago, Ill. App. filed March 1, 1910. No permanent magnet and coils are directly in series with transmitter.

1,181,722. BROILER; H. P. Ball, Pittsfield, Mass. App. filed July 11, 1913. Automatic heat control and food support adjustable with respect to heating unit.

1,181,723. MANUFACTURE OF ARMORED WIRE; H. P. Ball and L. Reichold, Pittsfield, Mass. App. filed Nov. 1, 1913. Wire is placed in trough; ribbon, which is then folded over.

1,181,733. CAM-OPERATED SWITCH; G. A. Burnham, Cliftondale, Mass. App. filed June 23, 1911. Particularly for motor starting purposes.

1,181,736. VENTING DOOR FOR CIRCUIT-BREAKER CASINGS; F. E. Case, Schenectady, N. Y. App. filed Aug. 11, 1914. Door is swung out by magnet in series with the switch contacts.

1,181,742. ELECTRICAL CONTACT; W. D. Coolidge, Schenectady, N. Y. App. filed Aug. 4, 1913. Tungsten contact united to ferrous base by film of copper.

1,181,803. ATTACHMENT PLUG; H. R. Sargent, Schenectady, N. Y. App. filed July 31, 1914. Wires are gripped between parts of plug.

1,181,811. CORED ARC-LAMP ELECTRODE; C. C. Wallace, Schenectady, N. Y. App. filed June 5, 1915. Has a separately baked mineralized core cemented in place.

1,181,838. SIGNAL; F. L. Cantrall, Ivy, Cal. App. filed Feb. 5, 1915. Call system for hotels, etc.

1,181,851. ELECTRICAL INDICATOR FOR STREET CARS; R. M. Craig, San Antonio, Tex. App. filed Feb. 1, 1910. Automatic street indicator.

1,181,867. TIMER FOR IGNITION SYSTEMS; W. Gadke, Philadelphia, Pa. App. filed June 3, 1914. Substantially constant action regardless of speed.